Concrete

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Concrete Placing Methods
Used in Building Tubes for
Detroit and Canada Tunnel

Concrete for the Ten 248-Foot Tubes for Under-Water Section of Vehicular Tunnel Cast at Two Locations—Land Plant Places Interior Concrete—Floating Plant Places Tremie Concrete

ONE of the largest engineering structures now under construction is the Detroit and Canada Tunnel, a $25,000,000 project that will link downtown Detroit with the business section of Windsor, Ontario, by means of a two-lane vehicular tunnel under the Detroit River. The total length of the tunnel, from grade to grade, will be approximately one mile.

In addition to the open inclines at each end of the tunnel, the project is divided for construction purposes into five sections. Sections 1 and 5, at the Windsor and Detroit ends respectively, constitute the approach tunnel sections, Section 1 being 602 ft. in length and Section 5, 627 ft.

Sections 2 and 4, connecting with Sections 1 and 5, are

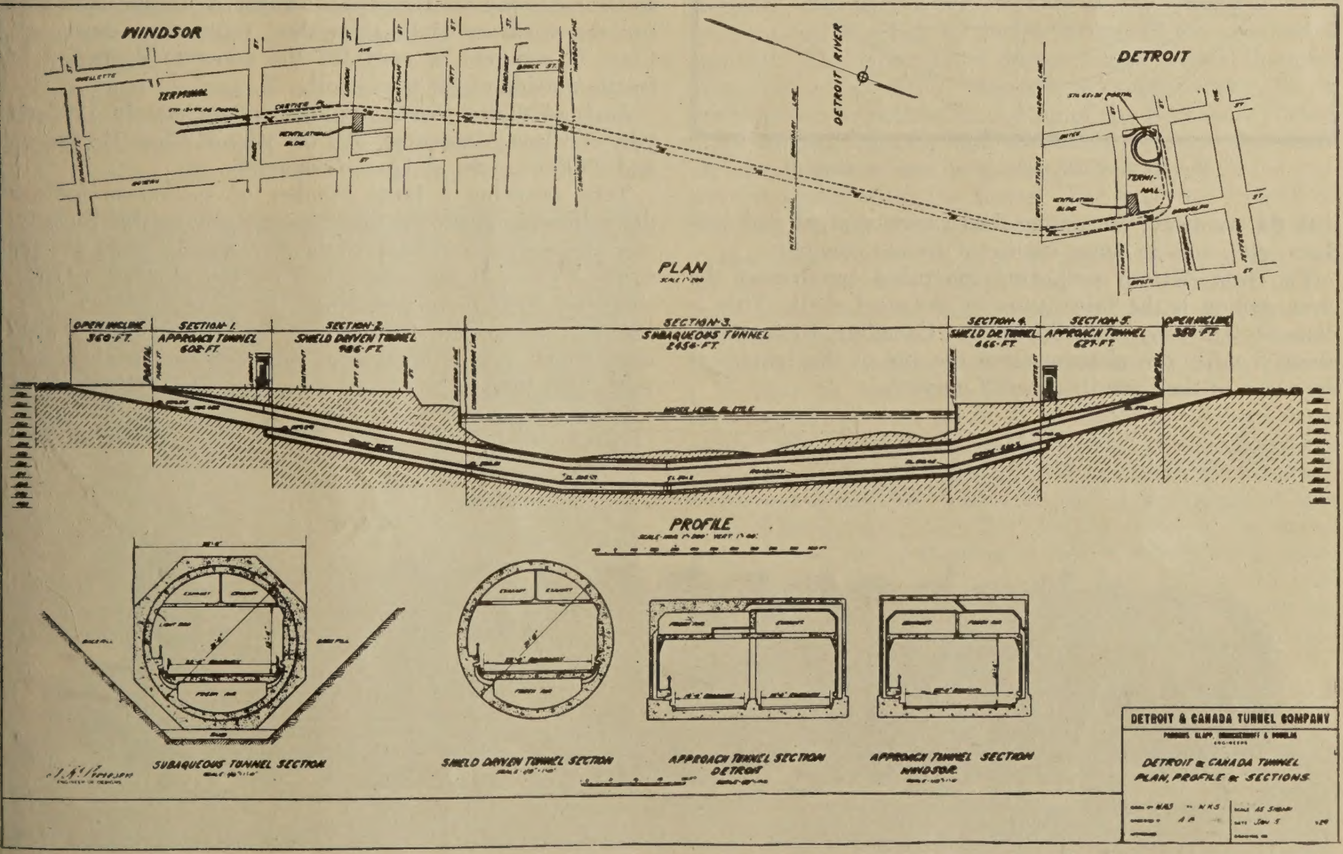

WINDSOR
TERMINAL
DETROIT RIVER
DETROIT
PLAN
OPEN INCLINE 360·FT.
SECTION·1. APPROACH TUNNEL 602·FT.
SECTION·2. SHIELD DRIVEN TUNNEL 986·FT.
SECTION·3. SUBAQUEOUS TUNNEL 2456·FT.
SECTION·4. SHIELD DR. TUNNEL 466·FT.
SECTION·5. APPROACH TUNNEL 627·FT.
OPEN INCLINE 380·FT.
PORTAL
PROFILE
SUBAQUEOUS TUNNEL SECTION
SHIELD DRIVEN TUNNEL SECTION
APPROACH TUNNEL SECTION DETROIT
APPROACH TUNNEL SECTION WINDSOR
DETROIT & CANADA TUNNEL COMPANY
DETROIT & CANADA TUNNEL
PLAN, PROFILE & SECTIONS
SCALE AS SHOWN

Figure 1

the shield-driven tunnels. There are 1452 ft. of this type of construction, of which 986 ft. are on the Windsor side and 466 ft. are on the Detroit side. Between Sections 2 and 4 is Section 3, the river section or subaqueous tunnel section, the construction of which will be described in this article.

An accompanying illustration (Figure 1) shows the general plan and profile of the entire project and illustrates the cross sections of the various types of construction as explained above. The entire project involves the use of some 80,000 cu. yds. of concrete.

The River Section

The river section is 2454 ft. long. It consist of ten tubes, varying in length from 220 to 250 ft. Each tube, as shown in the typical cross section (Figure 2) consists of a 3/8-in. steel shell, an inner lining of concrete, together with the roadway, ventilating ducts, service pipes and conduits, etc., and an outer casing of tremie concrete.

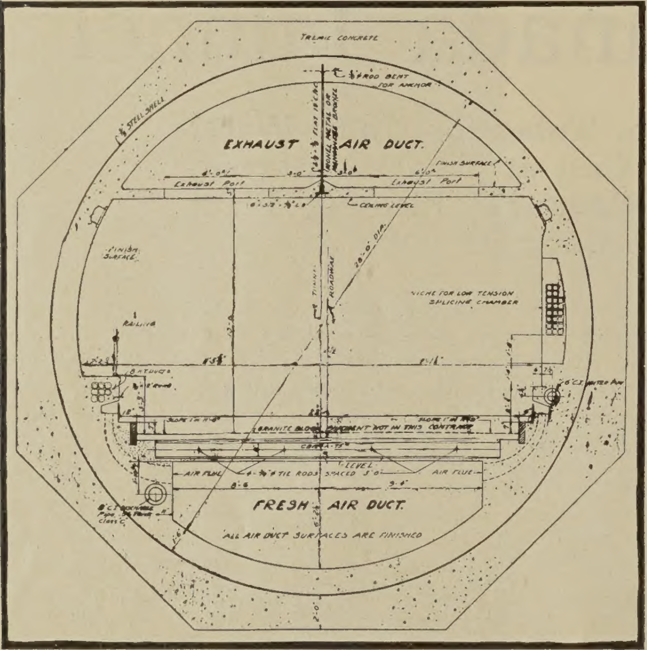


Figure 2. Cross section of river section

The first step in preparing the tubes comprising the river section is the fabrication of the steel shell. This is done at Ojibway, Ontario, by the Canadian Bridge Co., about 5 miles downstream from the site of the tunnel, at the plant of the Canadian Steel Company.

Each tube consists of a 3/8-in. circular shell of steel, 31 ft. in diameter, reinforced on the inside with heavy ring angles and on the outside by octagonal steel diaphragms spaced 12 ft. apart. The distance between parallel faces of the octagonal diaphragms is 35 ft., as shown in Figure 2. Reinforcement for the inside lining of concrete is placed and fastened when the steel shell is assembled.

When the shell is completely assembled, as shown in Figure 3, it is bulkheaded at each end and launched into the river. The bulkheads are of heavy timber, backed by heavy steel trusses and coated with Johns-Manville membrane waterproofing. When launched, the tube weighs approximately 500 tons.

The steel shell, bulkheaded at both ends, is then towed to a slip serving the Canadian Steel Co. plant, where it is tied up at the dock on which the concrete plant used for placing the interior concrete is located. Here the outside forms for the tremie concrete (see Figure 4) are fastened to the octagonal steel diaphragms and the interior concrete is placed.

Three Types of Concrete Used

Specifications call for three classes or mixes of concrete: Class A, 1:2:4 mix, using Super cement; Class B, 1:2:4 mix, using portland cement; Class C, 1:3:6 mix, using portland cement.

The proportions specified are only approximate, provision being made for changing the proportions of fine and coarse aggregate should the materials be such that a modification of the proportions would produce a denser concrete. Slump is limited to 6 in. Six sacks of cement are used for each cubic yard of Class A and B concrete. Four sacks are used for Class C.

Class A concrete is being used for the 1 ft. 6 in. inside lining of the steel shell. Class B concrete is used for all work inside the shell except the Class A lining. It is used for the roadway slab, sidewalks, ventilation ducts, etc. Class C concrete is used for the concrete deposited by tremie outside of the steel shell.

Each of the ten tubes requires approximately 1200 cu. yds. of Class A concrete, 300 cu. yds. of Class B concrete and 2300 cu. yds. of Class C concrete.

Tests covering a large number of specimens indicate the following approximate average strengths for the various classes of concrete: Class A concrete, 3500 lb. per sq. in.; Class B concrete, 3500 lb. per sq. in.; Class C concrete, 1600 lb. per sq. in.

Class A concrete for the interior lining of the shell used Super cement because of the need for an absolutely watertight tube. The tremie concrete, Class C, is not re-

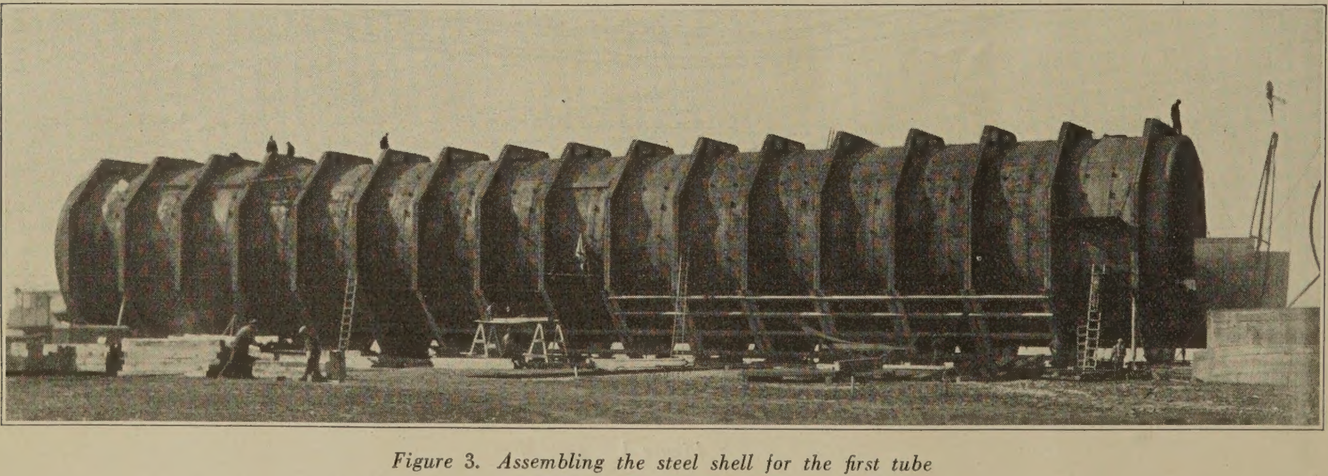


Figure 3. Assembling the steel shell for the first tube

quired to develop high strengths, its principal function being to provide the weight necessary to sink the tubes.

Placing the Inside Concrete

All the concrete for the inside lining and for the roadway, ventilation ducts, etc., is mixed and placed at Ojibway, Ontario. As previously mentioned, the steel shell, in which the inside reinforcement was already in place, was tied to the dock adjacent to the Ojibway concreting plant.

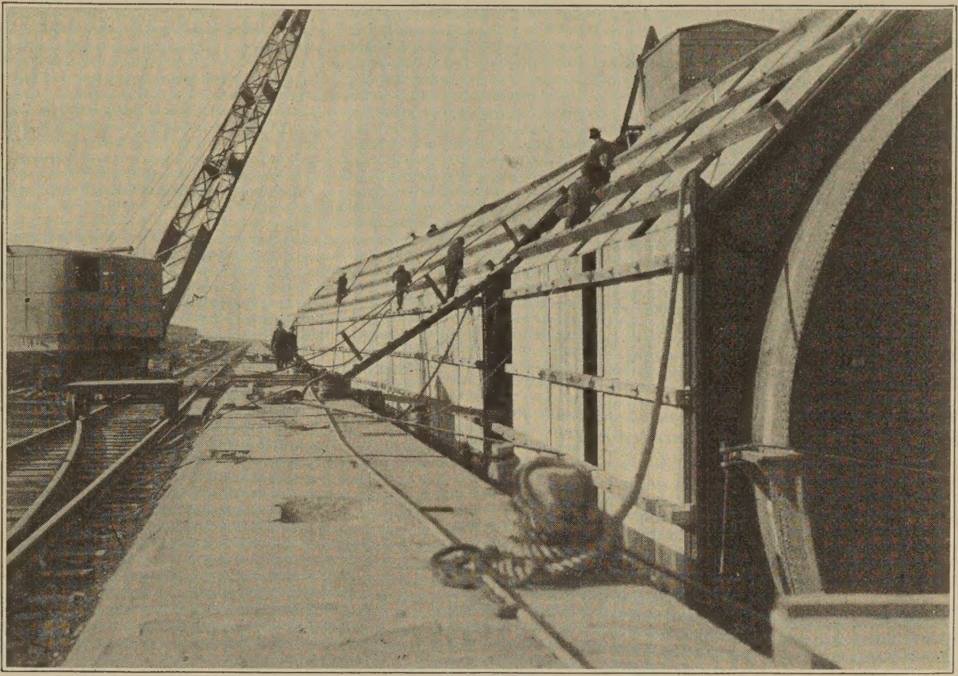


Figure 4. One of the steel shells in the slip at Ojibway. Forms for the tremie concrete are being fastened on the octagonal steel diaphrams. Note the bulkhead

This plant consists of a 1 cu. yd. Rex mixer, a Blaw-Knox batching plant, a Ford truck and a hoisting tower. Aggregates are received by boat and unloaded by clamshell in stockpiles near the batching plant. The Ford truck is used to transport the proportioned batches from the measuring bins to the mixer.

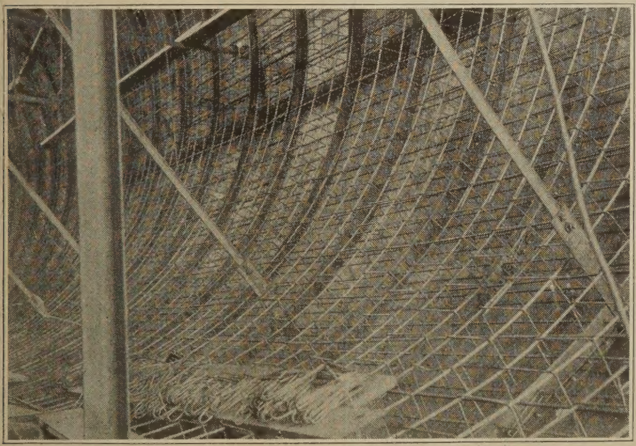


Figure 5. Reinforcing steel for the interior concrete lining is laced in place when the steel shell is assembled

Aggregates consist of gravel having a maximum size of 1 in. and a fineness modulus of 7.05 and sand having a fineness modulus of 3.27. They are proportioned 1:2.15:3.21. The water content varies with the location of the concrete because of the difficulties of placing, but is generally kept down enough to hold the slump within 6 in.

After the concrete is mixed, it is hoisted and chuted to a distributing hopper placed over the top of the tube. A track, upon which a 1 cu. yd. hopper car operates, is placed lengthwise on top of the tube. The car is filled from the distributing hopper and pulled along the track by means of a winch to the points where the concrete is dumped. The concrete is dumped into conical hoppers placed at about 30 ft. intervals at points where 12 in. openings were provided in the top of the steel shell. Below these conical hoppers and extending through the openings are 8-in. steel sectional chutes through which the concrete is conveyed to the forms. The pipe are jointed so that they may be swung to discharge at any desired point.

The inside forms are of 4 ft. square steel sections and are held in place by means of screw ties attached to the outer system of shell reinforcing, as shown in Figure 6. A riveting gun, made over into a vibrator, is used on the inside forms to compact the concrete as it is being placed.

As may be seen from Figure 7, the concrete for the invert which extends for a short width along the bottom of the tube, is placed without forms. It constitutes the first pour and is screeded off and finished with a trowel. Successive pours are made for the entire length of the tube. The second pour, the sections between the invert and the roadway slab on each side of the tube, is made with wooden forms, as is also the floor slab which constitutes the third pour. Above the roadway steel forms are used and pours are made 3 ft. 7 in. in height until the concrete shell is closed at the top.

In addition to all the interior concrete a keel of tremie concrete is placed under the tube at the Ojibway plant. This is necessary to stabilize the tube while it is being towed from the Ojibway slip to the tremie concrete plant where the balance of the outside concrete is placed.

While the interior concrete is being placed, the tube is gradually drawing more water until the inside concrete is completed, when the tube draws about 22 ft. of water.

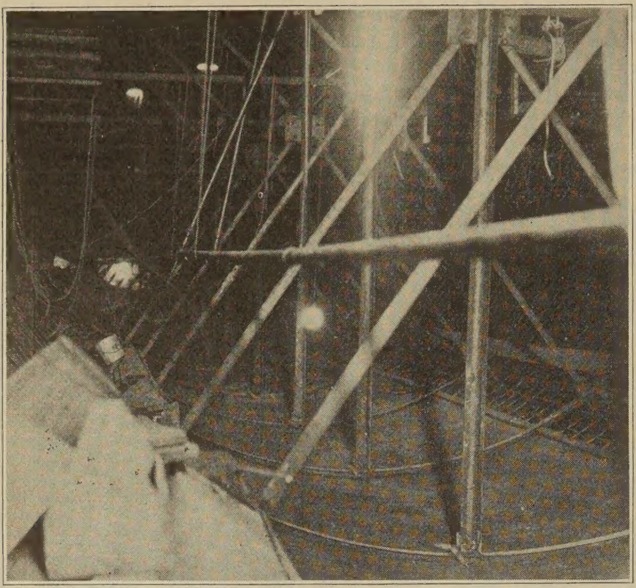


Figure 7. The invert was poured without forms. After the concrete was placed, it was screeded and finished to the proper contour

The Tremie Concrete Plant

The tremie concrete plant is moored to clusters of piles driven into the river bottom about 1000 ft. from the Detroit shore line approximately opposite the foot of Randolph St. This places it several hundred feet upstream from the tunnel location. Figures 8 and 9 illustrate the tremie concrete plant and the method of placing the concrete. The river here is about 35 ft. deep, permitting the full draft of the tubes.

The concreting plant is mounted on an old derrick scow, 120 ft. long, 36 ft. wide and drawing about 8½ ft. of water. It consists of a 1 cu. yd. Rex mixer, two 75 ft. Lakewood concrete towers, steel bins for 72 tons of aggregate and cement handling equipment.

Storage space for 3000 sacks of cement is provided on the scow, but the cement must be piled in two stacks to maintain the stability of the scow. A belt conveyor carries the cement from either of the two piles to the mixer. A bag cleaning machine and a sack baler are also installed.

In addition to the regular boiler, derrick and mooring equipment originally on the scow, separate hoisting engines have been installed for the buckets in the towers.

The aggregate storage bins are located above the mixer so that they feed by gravity through the measuring hoppers into the mixer. The proportioning equipment consists of measuring hoppers, cement hopper with scales and sand inundator. When the tremie plant was first started the cement was measured by weight and the aggregates were measured with the inundator but the waves affected the weighing equipment to such an extent that proportioning by weight was discontinued. The plant was then used entirely for placing tremie concrete and all materials were measured by volume.

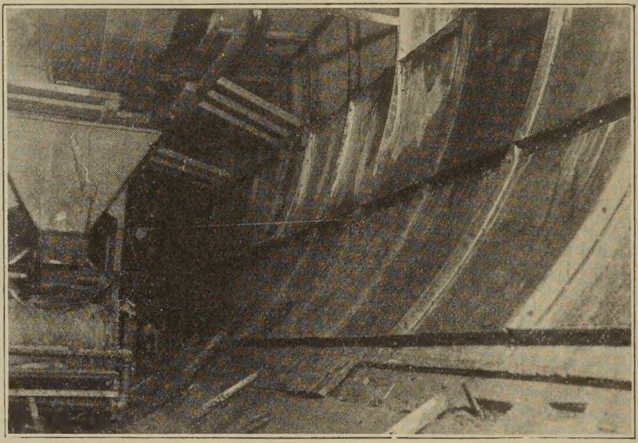


Figure 6. Sectional steel forms were used for lining the inside of the tube

The tremie concrete is considered of importance for

(Continued on page 53)

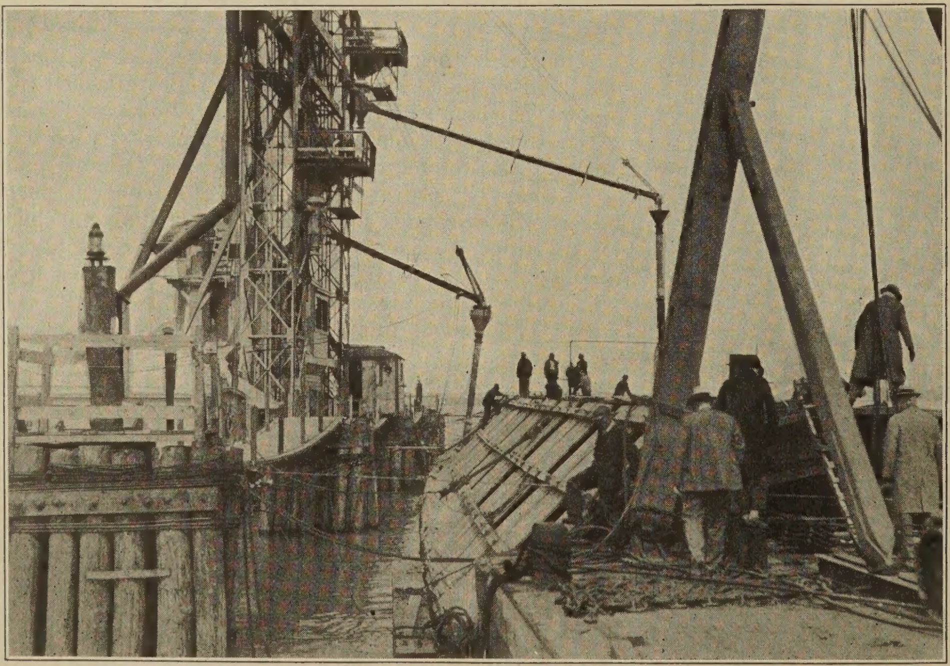


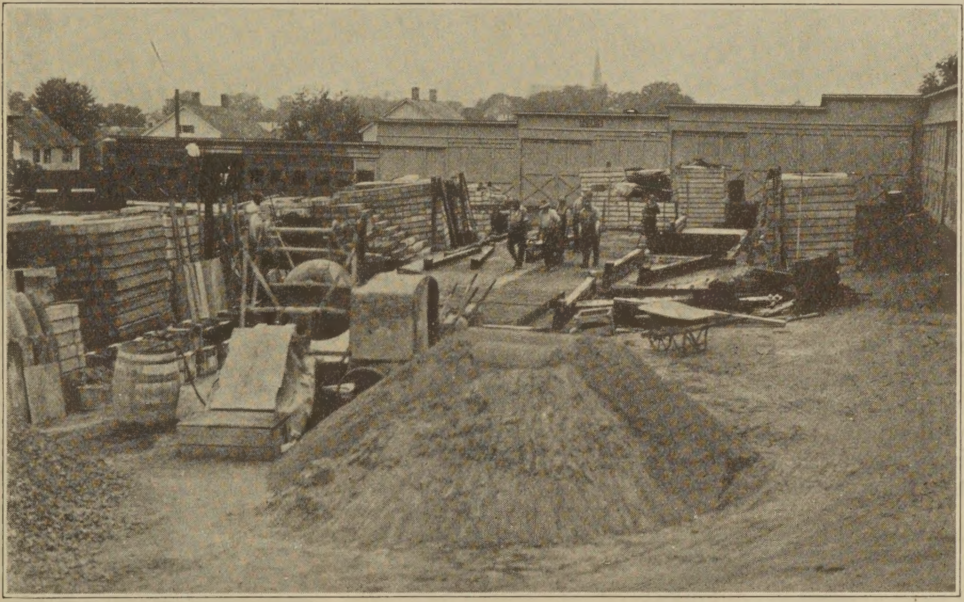
Figure 8. The tremie concrete plant was mounted on a barge and anchored near the final location of the tube

Connecticut Operates Own State Products Plant

State Highway Department Manufactures Highway "Accessories" in Well-Organized Products Plant—Make Section Markers, Boundary Stones, Park Posts, Cribbing, Sign Posts, Culvert Sections, etc.—Turn Out 70,000 Units Annually

UP in New England considerably more attention is given to the small details of road building than in many of our more western states, where mileage is great and road building still in the initial construction programs.

An example of this is Connecticut, a small state physically, and a yet smaller state from the standpoint of its road mileage. In spite of small size and low mileage, the state is known for the high quality of its roads and goes further by marking these roads in a thorough and not-to-be-mistaken manner.



A portable, 1-sack mixer is moved to aggregate piles placed near the forms and the concrete is placed directly from the mixer into the molds

Operates Own Products Plant

The work of producing signs and markers for the state system falls on the state operated products plant at Meriden. In this plant the state forces manufacture section markers, boundary stones, park posts, cribbing, sign posts, random stone for surveyors' markings, culvert stones, and triangular markers. Most of the products are concrete; all signs whether wood, concrete or metal are supported on concrete posts.

Last year a force of seven men under the superintendent produced about 70,000 units of all kinds. In addition to the routine work of the plant, the forces continually carry out experiments in better and more scientific control of the concrete work and also perfect new markers and posts as need for them arises.

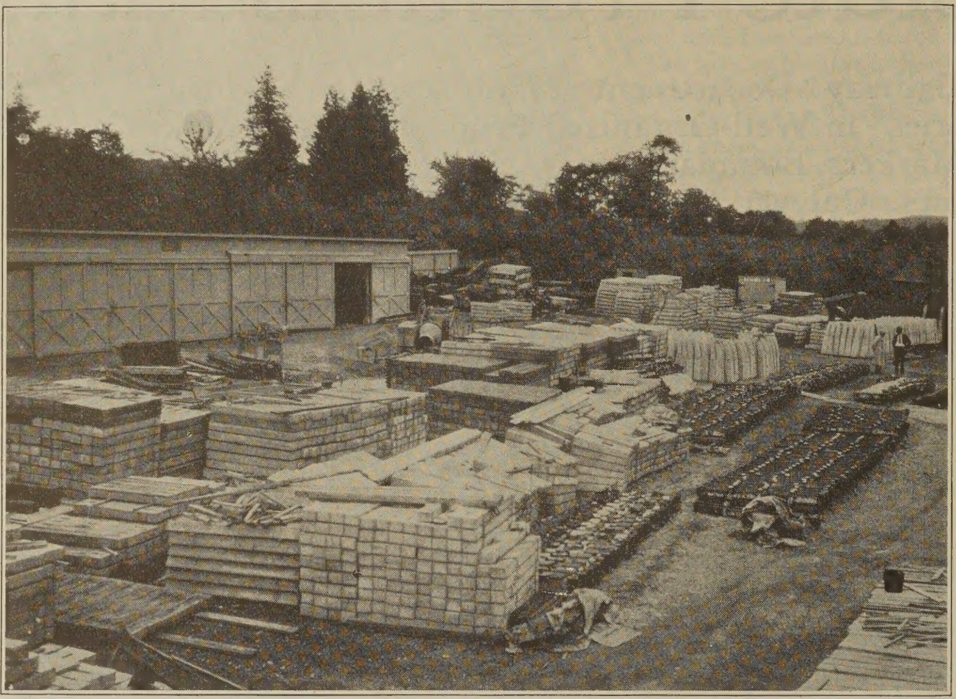
Plant Layout

The plant is laid out so that progressive manufacturing is done automatically. The yard is in the shape of a rectangle with the machine shop, garages and storehouses forming three sides. The fourth side is fenced in and has an opening for an entrance driveway.

The operations of the yard are built around the casting forms. Most of the work is done in and over them and mixing, curing and storing are all incidental to the work done at the forms. The plant forces have developed numerous sets of forms which facilitate work. All of the forms are of wood and are greased before pouring and cleaned after the stripping. Units which have reached the stripping age are taken from the forms and piled around the yard.

The concrete used in all the units is the same. The mix is 1:2:3 of dry consistency. Throughout all casting operations the water-cement ratio principle is followed. The water permitted is set at 4½ gallons to the sack. Coarse aggregate consists of crushed stone from local quarries graded from ½ to ¾ in. in size. The sand is secured locally and is generally of a brownish color.

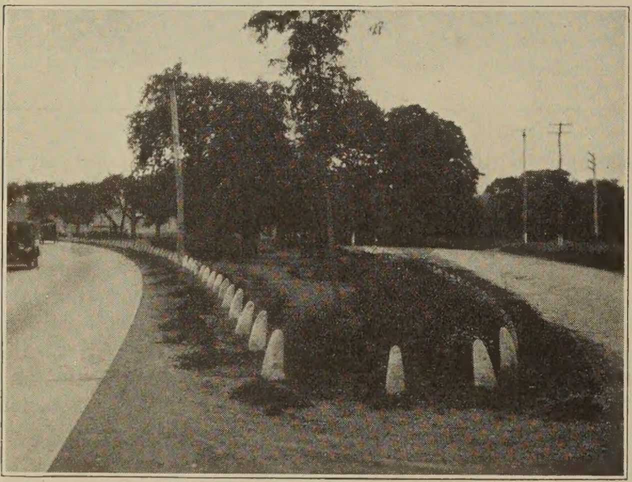
The materials for the concrete are piled near the forms which are to be filled and a 1-sack mixer is rolled up to the aggregate piles. This mixer is portable and is moved around the lot. The concrete is placed in the forms, well tamped into the corners and away from the edges and struck off. The forms are stripped 24 hours later and the units left in place for curing.



Four and a half gallons of water are used for each sack of cement and particular care is taken in curing the units properly

Careful Curing

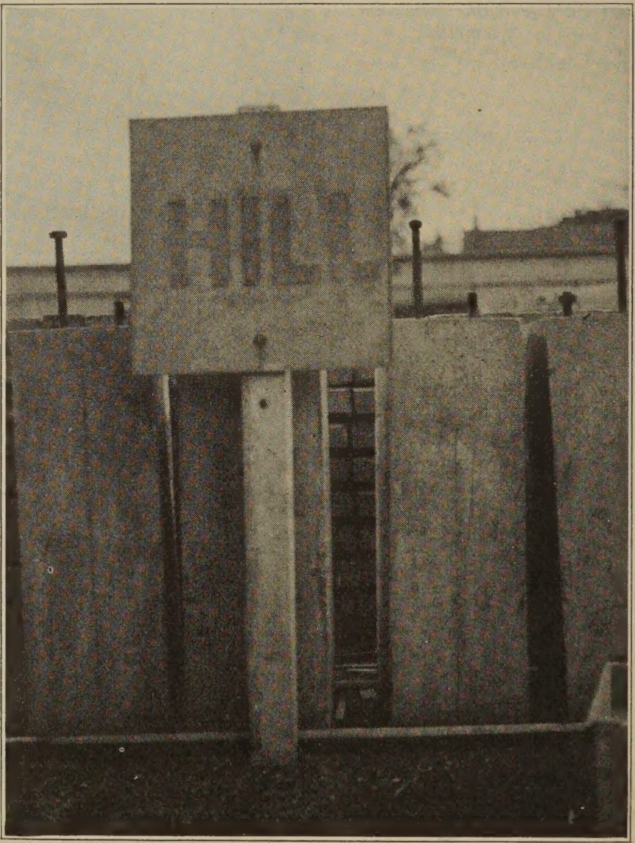
Great care is taken with the curing as the management believes that the best of concrete work before curing may be nullified by careless or inadequate curing. In hot weather the concrete units are sprinkled constantly. During the rainy weather this sprinkling is omitted just so long as the units get plenty of moisture. Manufacture of the units is carried on right up until time the snow flies. In cases of severe drop in temperatures, hot water is used in the mixer.



"Elephant tusks" made at the state products plant

Some of the units are placed immediately after they are cured, but others, especially those which add to the appearance of the highways are hand finished with carborundum stone and water to give a smooth and attractive finish.

Some interesting units have been developed at the plant. One unit is known as the elephant tusk. This is a square post which bends over and rounds off on the top end in a

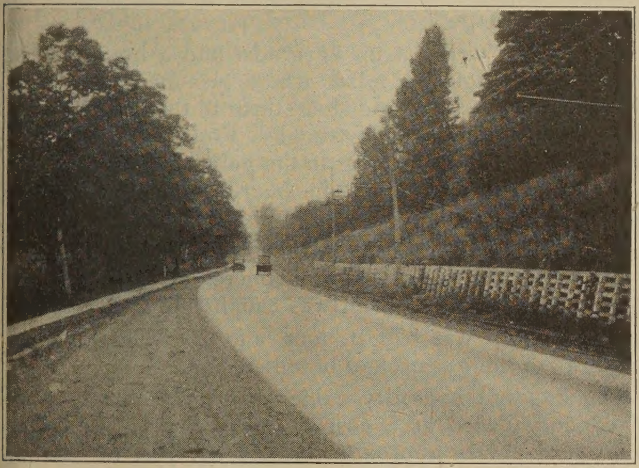


A road marker made of blue and gray cement shape much like the tusk of an elephant. Special forms are used for this unit and hand finishing is required to get the rounded end smooth and uniform. This unit is placed around small park plots and prevents cars from driving onto the plot, while at the same time adding to, rather than detracting from, the appearance of the plot.

Color Experiments

Experiments have been under way for some time to discover ways and methods of casting colored direction and warning signs. These units are supported on a concrete post and the concrete is cast and permanently held within a metal frame. The main board is cast first. A very fine finish mortar is used to give appearance. Then the sign impression is pressed into the background and the impression filled with a colored mortar. Considerable trouble has been encountered with varying degrees of expansion and contraction and with mortar cracking. It is felt, however, that such a unit possesses possibilities which warrant further experiment.

In addition to the all-concrete units made in the plant, numerous concrete posts are made to support the wood direction signs and warning signs for which Connecticut highways are famous. A yellow board with a black border is used and on this the arrow marking the direction or the alphabet letter for warning is painted. The newest design uses small glass reflectors set into the form of the marker. These reflect the light of the car and provide an illuminated, yet inexpensive, night marker.



Cribbing produced by state products plant is used to hold back the soil in cuts

In Connecticut the winters are long and snows deep. It is necessary to mark culverts and drains so that maintenance crews can find them to clean them out. For this purpose every culvert or drain is marked by a triangular concrete post set far enough back from the edge of the pavement that the blade of the scraper or the rotor of the plow will not injure it.

Cribbing is also extensively manufactured, for the state has many miles of roads cut into the sides of mountains and hills and some means of retaining the earth or rock is essential. Cribbing of a standard design is used for this purpose.

70,000 Units Annually

Production figures for this plant illustrate the extensive use this type of product can be put to and also indicate the possible production of a seven-man yard. The plant is now making every year approximately:

Park posts	4,000 units
Random stones	8,000 units
Town markers	4,000 units
Triangle posts	1,500 units
Culvert posts	300 units
Marker posts	20,000 units
Cribbing posts	30,000 units

The plant is under the direction of James Galligan, superintendent. In addition to the seven concrete men there are sign painters, wood workers, carpenters, repair men and others in the plant.

World's Largest Concrete Building for London

The enormous new reinforced concrete structure designed for the new Olympia in London will be the largest concrete building in the world, as well as the largest single building in the British Empire. Its main facade will be 330 ft. in length, and it will have four floors, each capable of holding 3,600 people, and to meet the demands of the London County Council the structure has been so planned that it can be emptied in two minutes.

The staircases are planned so that each runs to a different floor and stops there, the stairways to the top floor being in the corners of the building. The floor space of the building will be 250,000 sq. ft.

A peculiarity of this great exposition building will be that it will *look* like an exposition building and, moreover, it has been designed so that the upper part of it and the space between the windows can be used for large sign-writing or advertisements of each show.

The main front of the building has two horizontal windows five feet in height, one 130 ft. and the other 100 ft. in length, on each side of the great vertical window in the center of the building.

Pipe Manufacturers Hold Third Meeting at Los Angeles

The third annual coast-wide meeting of the California Associated Concrete Pipe Manufacturers was to be held at Los Angeles, Calif., on August 30th and 31st, at the Alexandria Hotel.

Among the outstanding events on the program were to be committee reports on sewer and culverts and on irrigation and septic tanks, by Henry Scholten and Fred Spiekerman, chairmen, respectively, and a trip to the plants of the American Concrete Pipe Company and United Concrete Pipe Company.

New Association Engineer in Southwest

Charles A. Clark, of Dallas, Texas, has been appointed manager of the Southwestern offices of the Portland Cement Association, with headquarters at Kansas City, Mo.

COMING CONVENTIONS

American Road Builders Association — January 11th to 18th, 1930. 27th annual convention and road show, at Atlantic City, New Jersey.

Concrete Reinforcing Steel Institute—September 30th to October 2nd. Semi-annual meeting, at the Wawasee Hotel, Wawasee, Indiana.

Fighting Floods with Sacked Concrete

Embankment Refilled with Sacked Concrete Rip Rap—Method of Placing—Mixing Plant

By C. H. WHITMORE

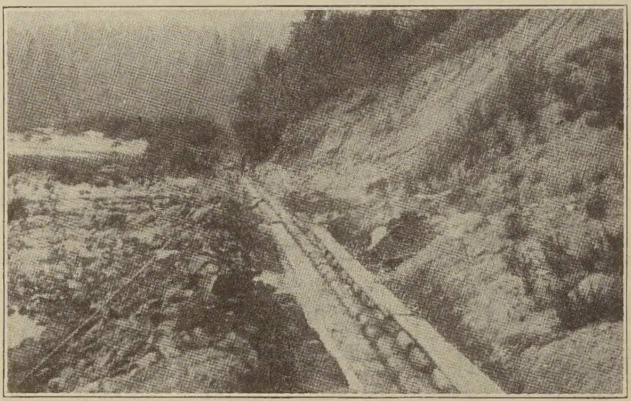
District Engineer, California Division of Highways, Department of Public Works

SHIVELY BLUFF in Humboldt County on the Redwood highway has been the source of extreme trouble either from slides or from the wash of the Eel River on the embankment side of the roadway.

The spring of 1928 found the roadway at this point washed out until two cars could not pass.

Embankment quantities were computed and it was found that about 8500 cu. yds. of material were necessary to fill out the roadway to its standard width, and a study of the cut side revealed the fact that probably 100,000 cu. yds. would have to be moved to get the roadway to a cut section which would be safe. This would also open up a new face, probably 100 feet high, which would cause many new slides.

Various methods of repair were considered but finally it was decided to refill the embankment which had been washed out and protect it against the river which rises, in flood times, about 25 ft. and carries very heavy drift.



The first tier of sacked concrete placed in successfully refilling an embankment on Redwood Highway, California

As the season was getting late, the proposition of filling the embankment and slope paving was abandoned in favor of sacked concrete rip rap, as high water might be expected at any time and with the use of the latter method, the fill and the rip rap protection could be brought up at the same time.

Method of Placing

Accordingly, a trench was dug about 2 ft. deep in bed rock at the cross-sectioned toe of fill, the first sack laid lengthwise, and the second row placed crosswise, to render better stability to the footing. The third row, as well as the balance of the rows for the entire height, was placed lengthwise again or parallel to the grade.

Previous experience has shown that a better bond can be secured by lapping the sacks to approximately half their width, which gives about a 1:1 slope to the finished wall.

The wall should be brought up in sections and as the concrete is mixed comparatively wet, the handling of the sacks promotes a kneading action which brings a film of grout to the outside of the sack, promoting a permanent bond between sacks when laid. When a row has become set, before the succeeding row is placed, a trench about 8 in. wide, dug immediately behind the "cold" row, should be filled with green concrete.

Precautions

Slope boards should be constantly employed to keep the slope true to line and care must be exercised to keep the rows from working out as wheeling over them tends to "mush" them toward the outside. Changes in slope tend to create knuckles which might cause trouble later when the green fill settles.

Two mixers were set up on grade, and a hopper built immediately below the mixer where two men load sacks with concrete, tie them and shoot them to the wheelers and placers below by means of troughs. From this point they are wheeled in wheelbarrows to the point of placing. This is accomplished on top of 2-in. boards laid on the newly placed sacks.

The fill was brought up with the assistance of a team and fresno. At this point the concrete work was shut down until the embankment was caught up.

This rip rap was 370 ft. long and 25 ft. high, being "toed in" to the old ground on either end.

Five hundred and fifty cubic yards of concrete were mixed and placed at a cost of $9.50 per cu. yd. One cubic yard covers approximately 2.7 sq. yds. of surface so the cost per square foot is $0.35.

Mixing Plant

The sand and gravel was hauled from a river bar by a 1½ cu. yd. truck and dumped at the mixers close enough so that it would be shoveled directly into the skip, proportioning by shovel counts, so no wheelbarrows were necessary. Material was loaded from the bar from a one-man gravel plant consisting of a small hoist and bucket which dragged the material up a runway and dumped into a loading box so there was no lost time for the trucks.

About 20 to 25 cu. yds. per mixer per day should be averaged, depending on the amount of mechanical trouble.

Mixing water was furnished from a pipe line and small pump set on the river bank.

Ordinary small grain, potato or small sugar sacks which have an open mesh are used. Sacks are tied with wire and tied close to the concrete so that a maximum rise per sack may be obtained when they are placed in the row.

This rip rap has stood over the winter and has two small slips in it, both of which would not have happened had the above directions been followed more closely. However, high water has been above these slip points twice with no damage to the work, and the slips can be repaired at nominal cost.

This work was designed and construction supervised by Richard H. Wilson, district maintenance engineer.

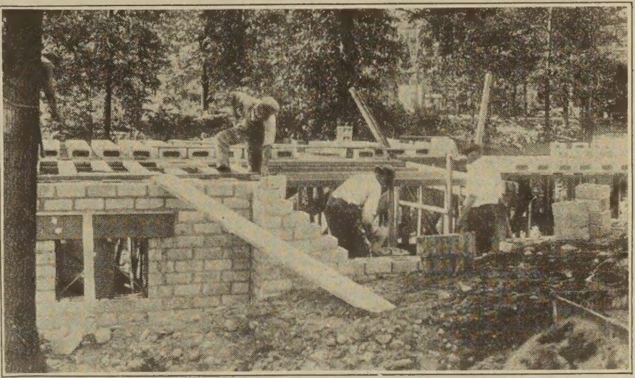
How to Build Tile and Joist Reinforced Concrete Floors

Helpful Information for the Builder Including Design Data, Hints on Form Construction and Correct Method of Reinforcing

THIS is the concluding article of the series describing construction of the three popular types of reinforced concrete floors suitable for houses or small buildings. The solid slab type was discussed in the July issue and ribbed floor construction was described in the Concrete for the Builder department of CONCRETE for August.

Tile and joist reinforced concrete floors are similar to the ribbed type in that the construction consists of a concrete deck or top supported by parallel reinforced concrete joists. The chief difference is that where removable forms are used to provide spacing between the joists in the ribbed type, hollow tile or block serve this purpose in the tile and joist floor and become part of the construction. The construction is monolithic because the concrete for the joists and top is placed in one operation.

An article published in the July issue, “How to Build



Building foundation walls and forms for tile and joist reinforced concrete floor

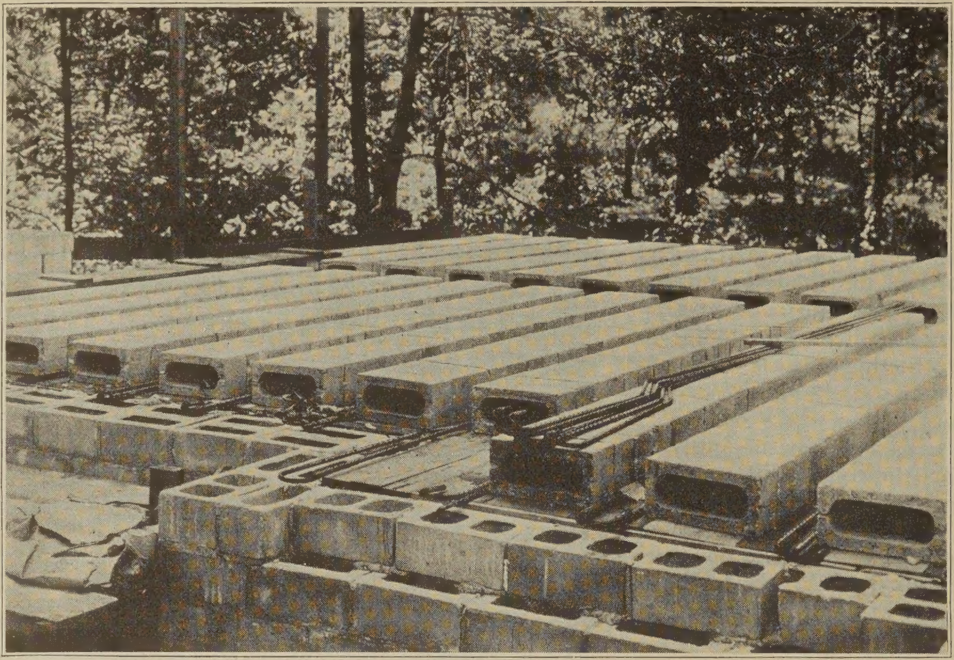
TILE AND JOIST SLAB

Table 5. Spans Simply Supported, B.M. = $Wl^2/8$

$f_c = 800$ lbs. per sq. in., $f_s = 20{,}000$ lbs. per sq. in., $n = 15$

Joist and Top					Safe Superimposed Loads in Lbs. Per Sq. Ft. for Following Spans									
Depth, In.	Width, In.	Spacing, In.	Weight Per Sq. Ft. Lbs.	Reinforcing Steel	10	12	14	16	18	20	22	24	26	28
4+2	4	24	56	2—⅝″ ϕ	66	45	—	—	—	—	—	—	—	—
				2—½″ ϕ	48	—	—	—	—	—	—	—	—	—
6+2	5	25	64	2—⅞″ ϕ	142	108	84	65	51	39	—	—	—	—
				2—⅝″ ϕ	116	86	55	26	—	—	—	—	—	—
8+2	6	26	73	2—1″ ϕ	—	—	—	107	87	71	58	—	—	—
				2—¾″ ϕ	—	151	119	89	57	—	—	—	—	—
10+2	8	28	86	2—1″ ϕ	—	—	—	166	138	116	96	66	45	—
				2—¾″ ϕ	—	170	133	106	66	—	—	—	—	—
4+2	4	20	58	2—⅝″ ϕ	86	62	45	—	—	—	—	—	—	—
				2—½″ ϕ	69	34	—	—	—	—	—	—	—	—
6+2	5	21	66	2—¾″ ϕ	—	129	102	80	55	32	—	—	—	—
				2—⅝″ ϕ	146	111	74	41	—	—	—	—	—	—
8+2	6	22	77	2—⅞″ ϕ	—	—	166	136	112	89	65	41	—	—
				2—¾″ ϕ	—	187	150	114	74	45	25	—	—	—
10+2	8	24	92	2—1″ ϕ	—	—	—	202	169	156	113	81	55	36
				2—¾″ ϕ	—	205	163	126	80	48	23	—	—	—
4+2	4	16	60	2—⅝″ ϕ	123	105	60	—	—	—	—	—	—	—
				2—½″ ϕ	107	56	—	—	—	—	—	—	—	—
6+2	5	17	70	2—¾″ ϕ	—	175	140	113	78	50	29	—	—	—
				2—½″ ϕ	148	86	44	—	—	—	—	—	—	—
8+2	6	18	84	2—¾″ ϕ	—	—	195	153	104	68	43	—	—	—
				2—⅝″ ϕ	—	189	132	80	44	22	—	—	—	—
10+2	8	20	100	2—⅞″ ϕ	—	—	—	214	178	130	90	60	36	18
				2—⅝″ ϕ	—	208	140	82	42	—	—	—	—	—

Solid Slab Reinforced Concrete Floors," discussed general construction information with reference to forms; lumber for form work; conduits, pipes and openings; foundation walls and footings; air space insulation; concrete for floors, beams and columns; placing concrete in forms; removal of forms; replacing supports and shores, and curing concrete floors. These practical hints for the builder apply as well to the construction of tile and joist reinforced concrete floors.



Steel reinforcing bars, placed in concrete joist between rows of tile fillers, give tensile strength

Table of Design Data

Design information for tile and joist floors is given in Table 5. Floors designed according to the data are suitable for residential or small building construction. The safe superimposed loads given are for tile and joist slabs simply supported, but if it is desired to increase the safe loads for use with restrained or continuous spans, investigation must be made of shear and bond stresses. One-half of the bars in each joist shall be bent as shown in the typical longitudinal section for tile and joist concrete residence floors. Adjoining rows of tile fillers shall have staggered joints. In computing shearing stresses 1 in. has been added to the joist widths to allow for the thickness of filler walls in contact with the rib. Tile filler weights are based on units of one-cell construction having walls 1 in. thick and made of stone or gravel aggregate. Any reduction due to the use of light-weight fillers should be allowed.

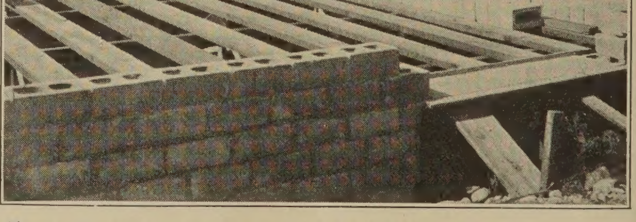
When engineers use Table 5 they should refer to the 1928 Building Regulations of the American Concrete Institute for conditions governing moment co-efficients.

Information that will be helpful to the designer is contained in the following technical notes that refer to Table 5.

Loads: The safe superimposed loads in pounds per square foot given in Table 5 are based on the controlling safe loads as determined by bond, shear or bending. The dead weight of the structural slab only has been deducted from the total safe loads and the weights of surfacing, partitions and plaster shall be deducted from the figures given to obtain the safe live-loads. The live-load recommended by the Building Code Committee of the United States Department of Commerce is 30 lbs. per. sq. ft. for residence floors of monolithic reinforced concrete construction.

Working Stresses: Working stresses are those recommended by the 1928 Building Regulations of the American Concrete Institute for 2,000-lb. concrete—7½ gal. of water (total) per sack of cement—and intermediate grade billet or rail steel.

Reinforcing and Temperature Steel: Reinforcing and temperature steel shall be placed properly as shown in the typical longitudinal section and securely wired. In all slabs ¼-in. round bars shall be placed on not more than 12-in. centers normal (at right angles) to the main reinforcement. Welded steel fabric of equivalent effective area may be substituted for the ¼-in. round bars. To further minimize the effect of shrinkage and temperature the recommendations of the 1928 Building Regulations of the American Concrete Institute should be followed.

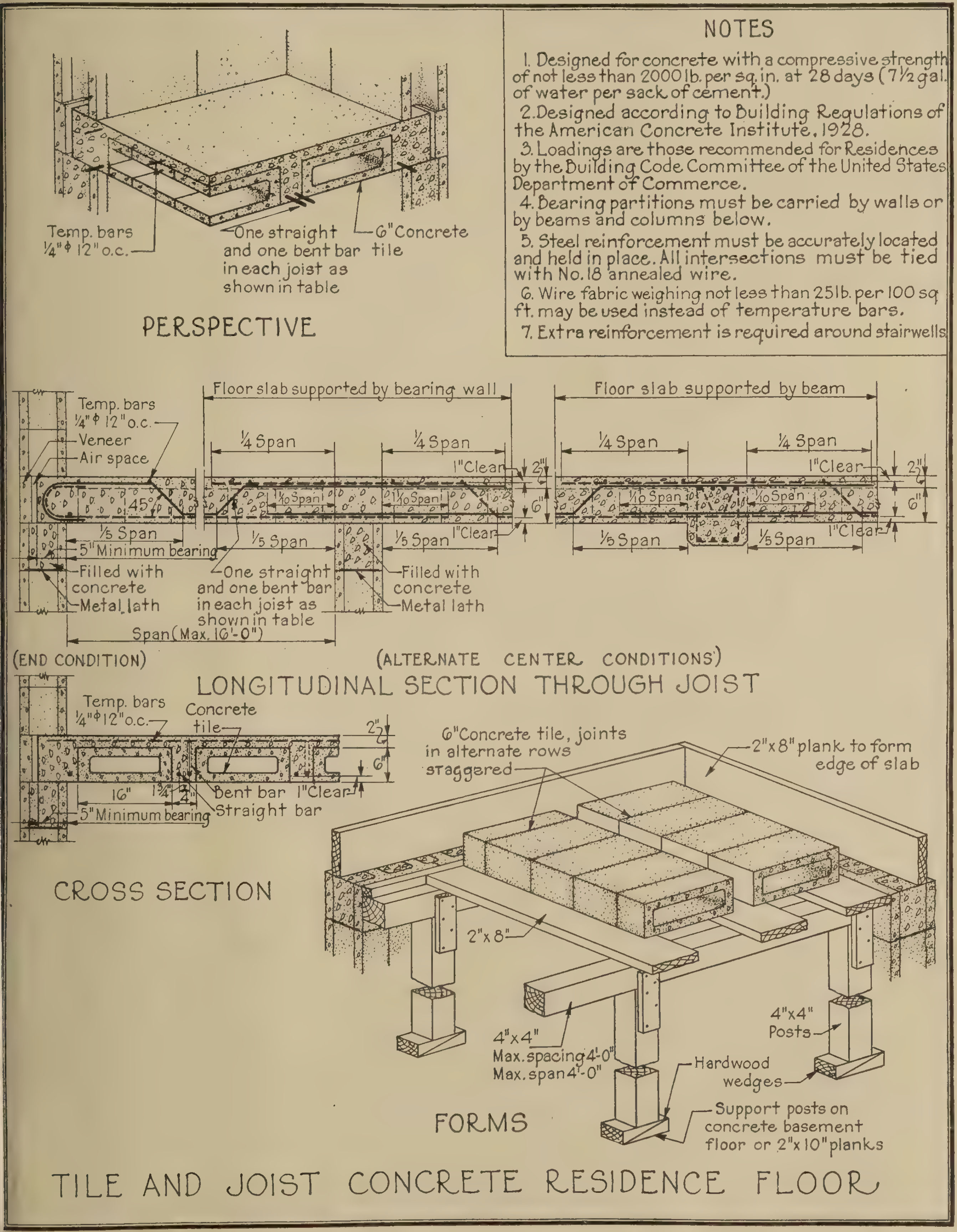


Type of open-centering used for building reinforced concrete floor of tile and joist type

Anchorage: Longitudinal steel shall be hooked at the supports or extended into the adjoining spans, as shown in the typical longitudinal section, to provide special anchorage.

Details of Construction

As has been stated, a tile and joist floor consists of parallel reinforced concrete joists which support a top that is usually from 2 to 3 in. thick. Construction details are shown in the accompanying drawing of a typical tile and joist floor. The unsupported span in this typical design is limited to 16 ft. in length. Longer spans require


Temp. bars
¼"ϕ 12" o.c.
One straight and one bent bar in each joist as shown in table
6" Concrete tile
PERSPECTIVE
Floor slab supported by bearing wall
Floor slab supported by beam
Temp. bars
¼"ϕ 12" o.c.
Veneer
Air space
¼ Span
¼ Span
1" Clear
2"
6"
45°
1/10 Span
1/10 Span
1/5 Span
1/5 Span
1/5 Span
1" Clear
5" Minimum bearing
Filled with concrete
Metal lath
One straight and one bent bar in each joist as shown in table
Filled with concrete
Metal lath
Span (Max. 16'-0")
(END CONDITION)
(ALTERNATE CENTER CONDITIONS)
LONGITUDINAL SECTION THROUGH JOIST
Temp. bars
¼"ϕ 12" o.c.
Concrete tile
2"
6"
16"
1¼"
2"
Bent bar
1" Clear
5" Minimum bearing
Straight bar
CROSS SECTION
6" Concrete tile, joints in alternate rows staggered
2"x8" plank to form edge of slab
2"x8"
4"x4" Max. spacing 4'-0" Max. span 4'-0"
4"x4" Posts
Hardwood wedges
Support posts on concrete basement floor or 2"x10" planks
FORMS

NOTES

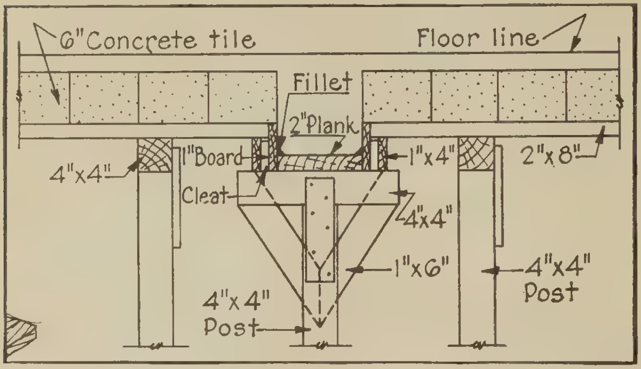
1. Designed for concrete with a compressive strength of not less than 2000 lb. per sq. in. at 28 days (7½ gal. of water per sack of cement.)
2. Designed according to Building Regulations of the American Concrete Institute, 1928.
3. Loadings are those recommended for Residences by the Building Code Committee of the United States Department of Commerce.
4. Bearing partitions must be carried by walls or by beams and columns below.
5. Steel reinforcement must be accurately located and held in place. All intersections must be tied with No. 18 annealed wire.
6. Wire fabric weighing not less than 25 lb. per 100 sq ft. may be used instead of temperature bars.
7. Extra reinforcement is required around stairwells

TILE AND JOIST CONCRETE RESIDENCE FLOOR

supports and these may be bearing walls or reinforced concrete beams as shown in the typical longitudinal section. Also, a bearing wall or beam of the same design is required under any first floor partition which carries a load from the second floor. When supports such as bearing walls or beams are required in the construction, the walls or forms for the beams and supporting columns should be built before the form work for the tile and joist floor is erected.

Form Details

An accompanying drawing gives the details of form work for a reinforced concrete beam as used with open-centering for tile and joist floor construction. The same type of concrete column as described in the article, "How to Build Solid Slab Reinforced Concrete Floors," can be used to support a beam under a tile and joist floor.



Cross-section of beam forms for tile and joist construction

When the supporting walls or forms for beams and columns are built, depending upon which type of support is used, posts and stringers for supporting the open centering (planks which carry the tile) are erected. The tile are supported on 2- by 8-in. planks spaced at proper intervals to allow approximately 2 in. of bearing of the tile on the plank.

Posts and stringers usually are of 4- by 4-in. stock. The maximum spacing of posts for an 8-in. tile and joist concrete floor is 4 ft., as shown in the detail of forms in the accompanying drawing. The 4- by 4-in. posts are supported on planks, usually 2- by 10-in. stock, to prevent settling. Where there is a concrete basement floor, however, these planks are not required. Hardwood wedges are placed between the base of each post and the plank or floor so that any difference in level may be corrected by adjusting the wedges. Briefly, the posts support the stringers and the stringers, in turn, support the 2- by 8-in. planks, allowing enough space between the rows of tile to form joists of the required width. This width is 4 in. in the typical design shown in the accompanying drawing.

In the space between the rows of tile, the main reinforcing steel is placed. The size of the bars for spans is indicated in Table 5. Two bars are used in each joist, as shown in the typical longitudinal section, one being bent up and the other remaining straight. The bars should be supported 1 in. above the plank and ¾ in. from the tile on chairs or small pieces of concrete. The ends of bars are bent so that they are at least 1 in. from the top, bottom and edge of the slab, as shown in the longitudinal section. This 1-in. covering of concrete gives the steel protection against possible corrosion or fire.

Conduits and Pipes

Conduits and pipes are installed or openings provided for them in the floor slab after main reinforcement has been placed in the joist forms. It is important that the work of electrical, heating and plumbing contractors, insofar as the structural floor is concerned, should be completed before any concrete is placed.

All conduits or pipes should be so located as not to reduce the strength of construction. Where structural concrete floors are to be surfaced with wood flooring, pipes or conduits usually are placed between the sleepers. When other types of floor finishes are to be used, conduits are placed in the top slab of tile and joist floors. Conduits or pipes should never be placed in the joists as such construction will displace the reinforcing steel or weaken the joists. Building codes and architects' specifications generally provide that outlet boxes for electrical fixtures or other openings be kept out of concrete joists. Headers between the joists for the accommodation of outlet boxes or other openings are formed by omitting one tile in tile and joist floors. Wood generally is used for forming square or rectangular openings; sheet metal is used for round or curved openings.

As stated in the notes pertaining to Table 5, ¼-in. round bar reinforcement on not more than 12-in. centers or welded steel fabric of equivalent effective area is laid in the top part of the slab, ¾ in. below the surface, when the concrete for tile and joist floors is placed. Temperature reinforcement, as this is called, is always placed at right angles to the main reinforcing steel; in this case, at right angles to the joists.

Plaster may be applied directly to the under side of a tile and joist floor, eliminating a hung ceiling. The under side of this type of floor frequently has a pleasing appearance without plastering.

Designing, mixing, placing and curing of concrete and the removal of forms were discussed thoroughly enough in the article, "How to Build Solid Slab Reinforced Concrete Floors," so that this information, which also applies to tile and joist floors, need not be repeated.

Government Conducting Pavement Tests with View of Reducing Cost

A concrete test pavement about one-half mile long, made up of slabs 9 ft. square and 7 in. thick, is being constructed at the Arlington Experiment Station of the United States Department of Agriculture by the Bureau of Public Roads. When tests are made, engineers of the bureau hope they will show that the prevailing mixtures used in making concrete for roads may be modified by the use of a larger proportion of coarse aggregate such as gravel, slag or crushed stone, so as to effect a substantial saving in cost and at the same time increase the strength and durability of the concrete.

The prevailing mixture for concrete pavements is one part cement to two parts of sand and three and one-half parts of crushed stone or gravel. Engineers believe that, if it is possible to secure as good or better concrete when the proportion of broken stone or gravel is increased to four and one-half parts, a saving of about $1,000 per mile in the cost of concrete roads will be effected.

The test road is being built just as an ordinary concrete road would be constructed except that the mixture for each slab will contain a different kind or amount of coarse aggregate and a different quantity of water. Mixing, placing and finishing of the concrete will be done in accordance with modern paving practice, using standard equipment.

After curing, the slabs will be drilled for cores and subdivided into beams suitable for flexure or bending tests.

~ EDITORIAL ~

A Tariff on Cement

NOW, when the subject of tariff revision is before Congress, the facts about the effect of a tariff on cement as they apply to the user should be understood. The problem of tariff revision is, or at least should be, a purely economic one. Politics should have no place in it if a solution that is fair both to the industry and to the purchaser is desired.

There can be no question but that a protective tariff on cement is needed, and cement users ought to employ their influence to secure it. The welfare of the cement industry is of vital concern to every user of cement. In justice to the cement manufacturer the user should consider the economic and not the political aspects of the problem in forming conclusions.

The matter of tariff revision is now before the Senate, the House of Representatives having made its recommendations. The cement paragraph in the House bill carries a duty of 8 cents a hundred pounds, or 30.4 cents a barrel. This is less by 8 cents a barrel than the figure which the Tariff Commission and the Ways and Means Committee found to be the minimum protective requirement for cement. It is 86 cents a barrel less than the difference between American and Belgian delivered costs.

Those opposing a protective tariff on cement say (1) that foreign imports are only a very small percentage of the cement consumed in the United States and that a tariff would affect only a small number of mills. They say further (2) that a protective tariff would tend to increased cement prices in the interior.

Regarding the first statement, the following facts are of interest: Forty-nine cement manufacturers have plants at seaboard. Of these, only six manufacturers operate inland plants. The result is, that importation of foreign cement, even though it be of comparatively small volume, forces these 49 manufacturers to sell an estimated 80 per cent of their production in competition with foreign cement at a loss. The result is that on May 1st six large seaboard plants had shut down and others have gone through periods of suspension.

Workmen in European cement plants receive about one-fourth the pay of workmen in American plants. The foreign cement comes over as ballast at a freight rate so low that it costs nearly as much to send cement from the Lehigh Valley to Philadelphia by rail as to ship it by boat from Belgium to Philadelphia. European manufacturers can put cement on our seaboard at a cost nearly that of American manufacturing costs at the plant.

Is it fair to expect American industry to compete under such obvious disadvantages?

The statement that a protective tariff on cement would raise prices in inland cities is absurd. Freight is so important a part of cement costs that high or low prices at the seaboard are not reflected in the interior. An examination of inland prices compared with seaboard prices over a period of years will demonstrate that fact without question. Even N. W. Richardson, representing the European manufacturers opposed to the tariff, testified before the Senate committee that "We can go only as far inland as we can truck cement, generally, from the piers."

These are facts that users of cement must take into consideration in forming their opinions on the tariff question as it relates to cement.

Reduce the Fire Loss

FOR ten years previous to 1927 the fire loss of the United States has been gradually mounting, but in 1927 there was a slight downward turn and figures compiled by the National Board of Fire Underwriters indicate a continued slight decline.

There are very few destructive agencies that take a greater toll in lives and in financial loss than fire. During 1928, 10,000 lives were lost and property valued at $472,224,568 was destroyed by fire.

Training in fire prevention, education to eliminate carelessness and similar activities have undoubtedly been responsible for the downward trend in the fire curve. Such efforts cannot be commended too highly, but there is another very effective aid to fire prevention that is still only in its infancy and that can be utilized for saving lives and money by the readers of this editorial.

The most effective fire preventive is fireproof construction. Concrete, as a building material, ranks among the most effective fire resistants. Whether it be used monolithically or as building units, concrete safeguards against fire.

Probably the greatest individual use to which concrete can be put to reduce fire loss is in concrete first floors for residences, stores, apartments, etc. It is in the basement that most of such fires originate and a concrete floor is a most effective method of preventing damage.

Concrete contractors and builders have an unusually forceful sales argument in the fire resistant qualities of concrete. It can always be used effectively, but Fire Prevention Week, October 6th to 12th, is a particularly favorable time to call the attention of prospective builders to the need for fireproof construction.

P. G. RILEY
President

T. G. McGOVERN
General Supt.

P. G. RILEY
GENERAL CONTRACTOR

~~701 Temple Street, Pittstown, N. Y.~~

Los Angeles

Dear Mac:

I was glad to see you have joined that contractors' organization, for not having much to do I have been attending several of their meetings out here.

In the main, I think their ideas and members are O.K., but there is one point I am not quite clear on. Possibly you will be able to put me right.

In most of their meetings I hear the irresponsible contractor spoken of quite often and I sure would like to get a true definition of the irresponsible contractor. In fact, I think your association should make known in its publication or some other publication, if they have not already done so, their true conception of the irresponsible contractor because their attitude might be misconstrued in a way that would reflect unintentionally on some good contractors who are not members and therefore keep them from joining up.

I have in the past had to dig down into my pockets aplenty when sub-contractors did not make good and the law provided the general contractor had to make good. How can the irresponsible of any walk of life be eliminated no matter how much suffering they cause? Are they irresponsible for lack of ability, or lack of capital, or were the breaks against them? How many of your members are there who might sometime in their upward course, be called irresponsible contractors or might they not be called irresponsible now at times when the breaks are against them, if they had not accumulated a surplus of cash and reputation?

Why, I remember one contractor who was once a barber, who thought contracting would be a worth-while vocation and so was helped into his newly chosen career by credit given him from several sources and now is a member of your association. But back in the beginning, I remember, he was called upon to build a cofferdam and had to look in the encyclopedia to find out what it was. He won eventually through experience he got and later through some luck and by a great deal of nerve. But he sure wasn't always responsible.

I will agree that less latitude in the matter of credit would stop some beginners from going "hog-wild," but I think it would be un-American to organize against the promotion of ability even though from the start it is sometimes necessary for a man of ability to start on a shoestring and gamble on the possibility of bad breaks.

How can a man attain a reputation of responsibleness without a trial, and even though he fails once or even twice, should he never be given another chance to be known as a responsible contractor of your fraternity? It might be well for each man in your association to ask himself, "Am I a responsible contractor?" and then ask himself how he became one.

Before backing a plan to eliminate forever the irresponsible contractor from your midst, rather make rules to assist him in being a responsible competitor and probably a better one.

Possibly, not being well informed as to the aims, rules and regulations of your association, I am a little off the track. But if you cannot put me right, sometime when you meet the general manager of your organization, have him write me a letter that will put my mind at rest on this subject.

Sincerely,

P.G.

P. G. Riley is a former contractor spending his days of retirement under California's sunny skies. Mentally, however, he is almost as much "in the game" as he ever was.

Perhaps his greatest pleasure is in keeping touch with his superintendent, Tom McGovern and, off and on, his secretary, Anna Ryan. His being away from the scene of activity has given P. G. some new viewpoints and he manages, in his letters, to convey to the young folks some of the ideas in the back of his head.

In one of his recent letters, he told of a conversation he had with a former mixer manufacturer on the subject of price versus quality. P. G.'s manufacturer friend claimed that the buyer can raise the standard of quality in equipment by forgetting price and demanding high quality.

In a later letter, Riley related the views of a young engineer friend who scored the mixer purposely designed and claimed to meet every need of every user and disguised with inexpensive selling points to hide its lack of substantial construction.

Concrete Rock Bear Dens

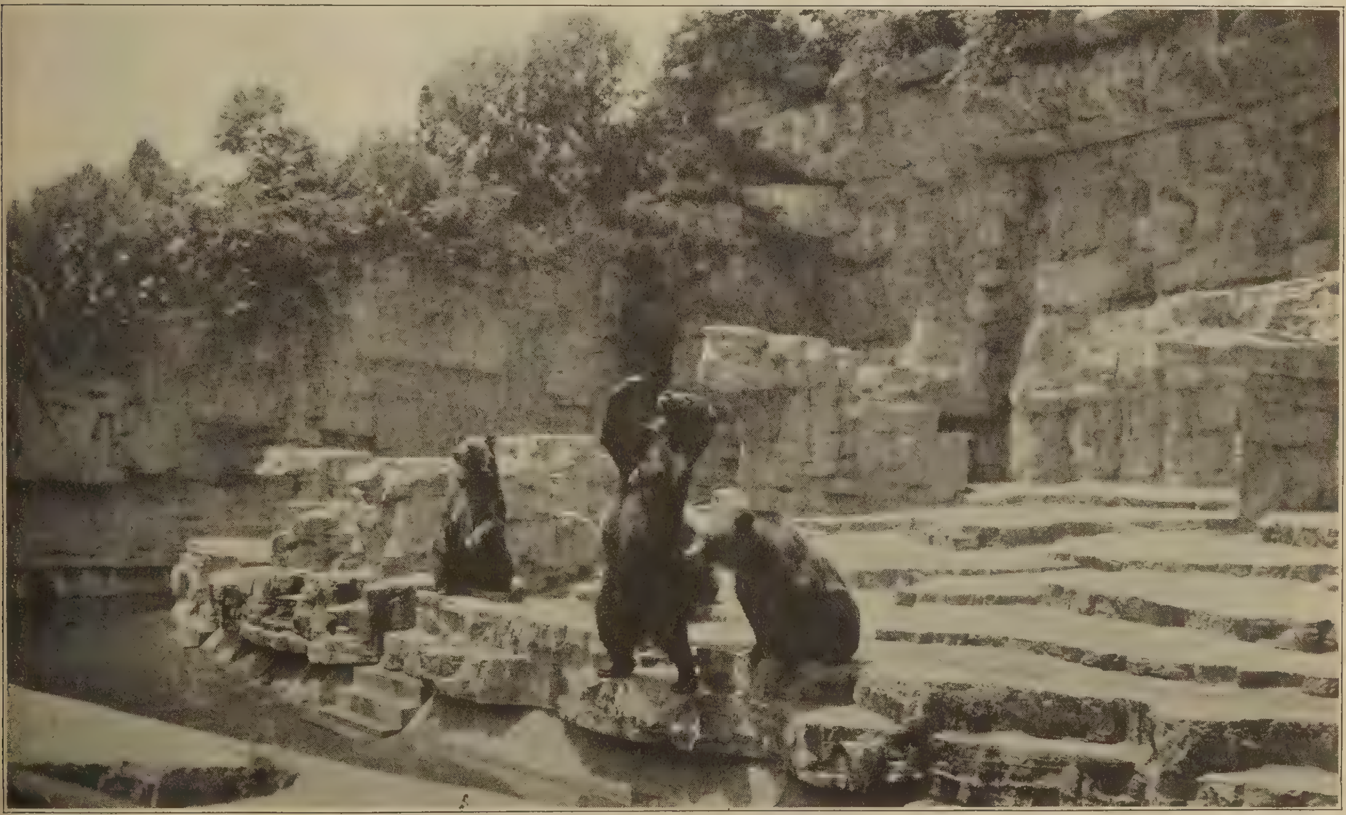
Man-Made Stone Used to Reproduce Native Environment in Municipal Zoo, Forest Park, St. Louis—Step-by-Step Story of Models, Molds and Construction

By CARL H. JOHNSON
As told to Robert H. Moore

Animal dens made of concrete and built to resemble natural rock formations are believed to have had their origin in the Denver, Colorado, Zoo in 1913, when Carl H. Johnson, author of this article, interested V. H. Borchard, director of the Denver Museum, in this method of housing zoo animals.

Realizing that zoo animals could be better displayed if they were housed in dens similar to their native haunts, Mr. Johnson experimented with concrete for this purpose for several years. He and Mr. Borchard then reproduced a number of typical rock formations in concrete and built a small model den. Their work so impressed the commissioners of the Denver Municipal Zoo that this group commissioned them to start construction of full sized dens. The Denver project was completed in 1913. So realistic were the finished dens that their fame soon spread and in 1920, when it was decided to provide new bear dens at Forest Park, St. Louis, the services of Messrs. Borchard and Johnson were obtained. The former did not live to see the completion of the work, but the job was successfully finished by Mr. Johnson, who is now superintendent of construction for the new dens being built at St. Louis. John E. Wallace, architect for the Municipal Zoo, is also supervising the work.

That the park commission of St. Louis was successful in providing native environment for the big family of bears instead of the conventional animal cages is evidenced by the accompanying photograph which is a present-day picture of the dens built in 1920. These dens proved so satisfactory and economical that the park commission has authorized construction of five more concrete rock animal pits, as they are sometimes called. These are described in Mr. Johnson's article.



Bear pits in the Municipal Zoo in Forest Park, St. Louis, Missouri, where natural environment is reproduced in concrete

THE concrete rock animal dens now being built in Forest Park, St. Louis, Missouri, are of the same type of construction as the bear pits built there in 1920, with the concrete simulating the limestone strata around St. Louis. The dens will be barless and fenceless, the animals being kept in by dry moats. One of the new dens will be a home for a family of prairie dogs, a second will house a group of Himalayan sun bears, some young American black bears will live in the third, wolverines will be housed in the fourth and the fifth will be a home for raccoons.

True to Nature

The most important consideration in building concrete rock animal dens is to make them resemble the rock formations that are characteristic of the country in which they are built—in this case, the limestone strata in Missouri. I traveled around the state a great deal before finally selecting a bluff along the Mississippi River near Herculaneum, in the foothills of the Ozark Mountains, 25 miles south of St. Louis, for my rock models. Selecting the model does not mean that the intention is to reproduce any certain section in exact detail. The model merely furnishes characteristic rock strata from which a number of small impressions can be made.

Approximately 37 impressions were taken from the bluff at Herculaneum, the sections being selected at random. Waste molds, which will be described presently, are made from the models. These are pieced together to suit the dimensions and layout of the proposed animal dens. When concrete is deposited against the molds, the finished job becomes a rock formation duplicating the original rock in strata but not necessarily in size or shape.

Patterns being used to build the new dens are the same as those which were used in forming the bear pits that were built in 1920, but the new structures will look entirely different. These same patterns could be used for building practically any number of dens and they all would have a different appearance.

Making the Molds

In making the original impression from the natural rock the desired section was first framed with a 1- by 1-inch ridge of plaster. The rock face within the frame was then covered with molder's clay to a depth of ½ inch, the clay being pressed into depressions and worked around projections. A plaster cap about 1½ inches thick was then placed over the clay. When the case hardened and could be handled without breaking, it was removed, the clay raked out and the case replaced. The space between the case and the rock face was then filled with glue. When this stiffened a negative glue mold was formed, as shown in Fig. 2 of the panel showing the sequence of operations.

Glue molds thus obtained are not suitable for forms, however, and several other steps are required to obtain waste molds that are used on the job as forms for the concrete. The next step was to make a plaster model from the negative glue mold. This master pattern is shown in Fig. 3. This is identical with the original bluff face, as the drawings show, and is kept permanently as the master pattern. (The negative glue mold taken directly from the bluff face cannot be preserved as a master pattern because the glue deteriorates.)

As shown in Fig. 4, a number of negative glue molds are made from the master pattern, following practically the same practice as used in obtaining the impressions of the original bluff face. Duplicates of the master pattern (Fig. 5) are obtained from the negative glue molds. These duplicates are used in making the waste molds for use on the job. First, a negative plaster mold as shown in Fig. 6

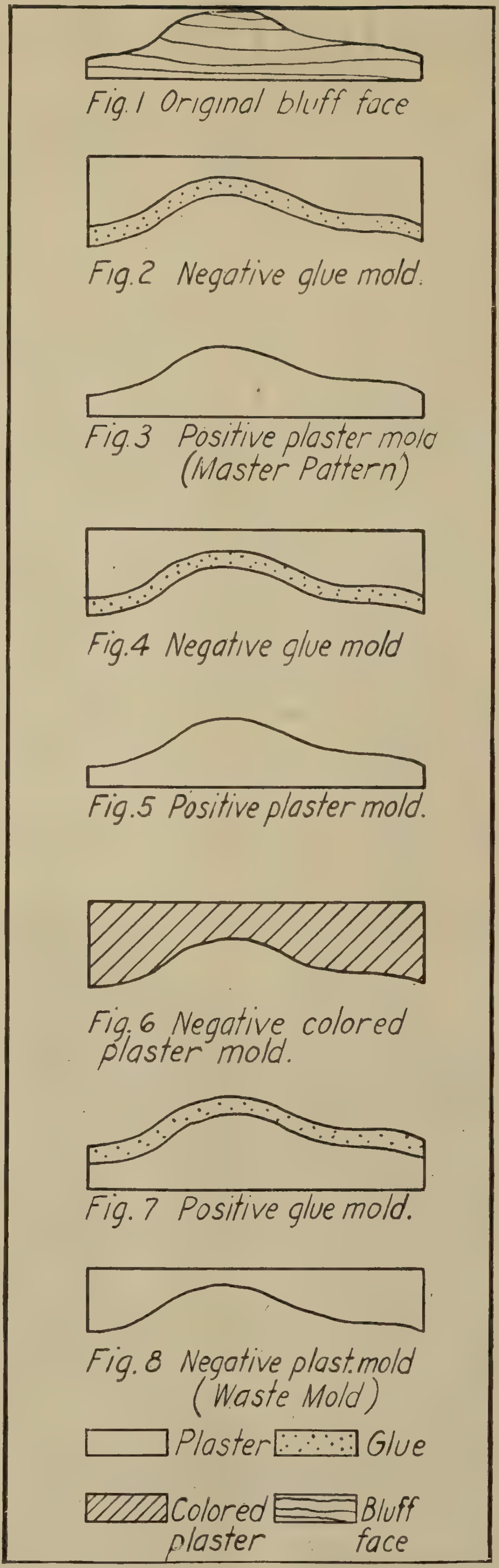


Fig. 1 Original bluff face
Fig. 2 Negative glue mold.
Fig. 3 Positive plaster mold (Master Pattern)
Fig. 4 Negative glue mold
Fig. 5 Positive plaster mold.
Fig. 6 Negative colored plaster mold.
Fig. 7 Positive glue mold.
Fig. 8 Negative plast. mold (Waste Mold)
Plaster
Glue
Colored plaster
Bluff face

Drawings showing the sequence of operations. Figure numbers referred to in the text apply to the figure numbers as shown in this cut

Front and rear views of plaster waste molds. Note the 2-by-2's that provide rigidity

has to be made. This plaster is colored so that when any pieces of the positive mold cling to the new negative mold this will show up immediately and the pieces can then be chipped away.

The next to the last step is to make a positive glue mold, as shown in Fig. 7, from the negative plaster mold. The waste mold which is really a negative plaster mold, as shown in Fig. 8, is made directly from the positive glue mold. The plaster waste molds are braced with 2 by 2's, as shown in an accompanying photograph, to give them rigidity and to permit handling on the job.

About 20 waste molds can be made from one positive glue mold and as many positive glue molds as are needed can be made from one negative plaster mold. The procedure just described is followed for each rock impression taken from the original bluff.

The steps shown by Figs. 2 and 3 and 4 and 5 are identical. This is necessary to prevent the possibility of anything happening to the master pattern. The negative plaster molds could be made from the master pattern, but it is safer to make duplicate master patterns for this purpose.

When concrete is deposited against the waste molds an exact reproduction of the original rock is produced. Now here is an interesting thing—for every original rock impression we can produce two absolutely different rock faces. One is an exact duplicate of the original rock and

Waste molds in position upon the foundation wall ready for the first application of concrete

Applying first concrete against waste molds. Proportions of white and gray cement are varied to produce variation in color is produced by using the waste mold shown in Fig. 8. The other is just the reverse, being produced from a waste mold of the type shown in Fig. 5. Duplicates of the master pattern can be used as waste molds for this purpose or waste molds can be made from the plaster mold shown in Fig. 8. From our 37 original rock impressions we get 74 rock patterns.

When the bear dens were built in 1920, all 74 patterns were used for the work, but for the dens now being built these patterns are used for only the walls. I have taken several impressions of the rock strata at the Wilson Quarry (near St. Louis) which I am using as patterns for the floor, ledges and overhang of the new dens.

Erecting the Forms

While the waste molds are being made, the sites for the dens are prepared. Hollows are made for pools, the ground is built up where necessary, drainage is put in and other work of this kind is finished. A concrete foundation wall about 12 inches thick is then built. This follows the shape of the finished dens and serves as a foundation upon which the concrete rocks are built. In the rear and along the sides of the dens where the rock formations are to extend quite high, a second wall is built. The space between this and the front wall is usually about 4 or 5 feet. This wall follows the outline of the dens and extends as high as the rocks will be placed. It serves both as a retaining wall for the earth that will later be packed against it and as a support for the rocks. The space between the two walls provides a passageway from den to den as well as a shelter for the animals. It is covered over and concealed, as will be described later.

Inasmuch as the shape of the dens would make wooden form construction rather expensive, an unusual method of form building was used on this job. Reinforcing rods were used to build two frameworks following the outline of the dens. These were spaced 8 inches apart, the thickness of the concrete wall, and then covered with metal lath. The forms were completed by a scratch coat of cement-sand mortar. Concrete was then placed in these forms. So far as I know, this is the first time forms of this kind have been used, and they have been very satisfactory.

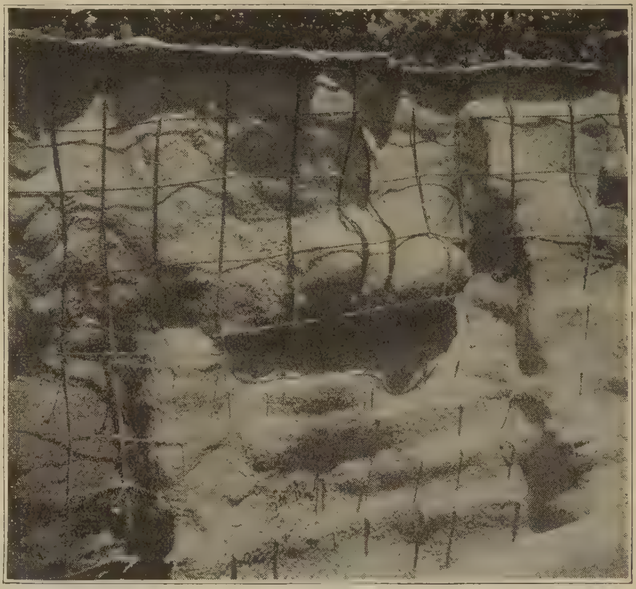
When the walls have hardened sufficiently the waste molds are set in position, as shown in an accompanying photograph, being placed more or less at random but conforming to the general contour. They are braced in position with wooden scaffolding, as is also illustrated. The various waste molds do not fit together perfectly and there is no intention that they should. When they are all in position, plaster is used to fill in depressions along the edge of one section to meet projections in another and vice versa. This process finally joins all of the sections together. The faces of the molds against which concrete is deposited are then painted with a special paint to prevent the concrete from bonding to them.

Placing the Concrete

The concrete for the rock walls is placed with a cement gun. The walls are built up gradually until the proper thickness, which varies from 3 inches at the top to 5 inches at the bottom, is obtained. The first application consists of a 1:2 mix made up of 3 parts of white cement, ½ part of gray cement, 3 parts Ottawa sand and 4 parts Merrimac sand. To prevent uniform color in the face of the concrete rock formation, the proportions of white and gray cement are varied. As the concrete is first sprayed against the plaster molds, the pressure of the gun is reduced to a minimum. This is to prevent the concrete from penetrating into the plaster waste molds. As the face of the molds is covered the pressure is gradually increased.

Method of Reinforcing

The first application builds the walls up to about ½ inch thick. When this concrete has hardened, reinforcement consisting of ¼ and ⅜-inch round bars is placed as shown in one of the illustrations. These rods are bent to follow the contour of the rocks. Horizontal tie-rods, at 2-foot intervals, anchor the rocks to the retaining wall. When the reinforcing and tie-rods are in place, the second application of concrete is placed with the cement gun. The mix is one part portland cement and 3 parts Merrimac sand.



Concrete below has been placed to the desired thickness; above portion has received only the first application. Reinforcing rods are bent to the contour of the rocks

As previously stated, a space is left between the front wall and the rear retaining wall. To cover this passageway, a form is built of reinforcing rods and metal lath, as shown in an accompanying illustration. A scratch coat of mortar is then applied and concrete is deposited to a depth of about 4 inches. Later, this is sodded over and shrubbery planted.

Removing the Forms

The waste molds are left in place until all concrete work is finished. They cannot be removed intact, but have to be broken away from the concrete. This, by the way, is the reason why they are called "waste molds," for they cannot be used again. When the waste molds are off and the concrete cleaned, the landscaping is done and all is ready for the animals to move in. The dens now under construction will probably be completed this fall.

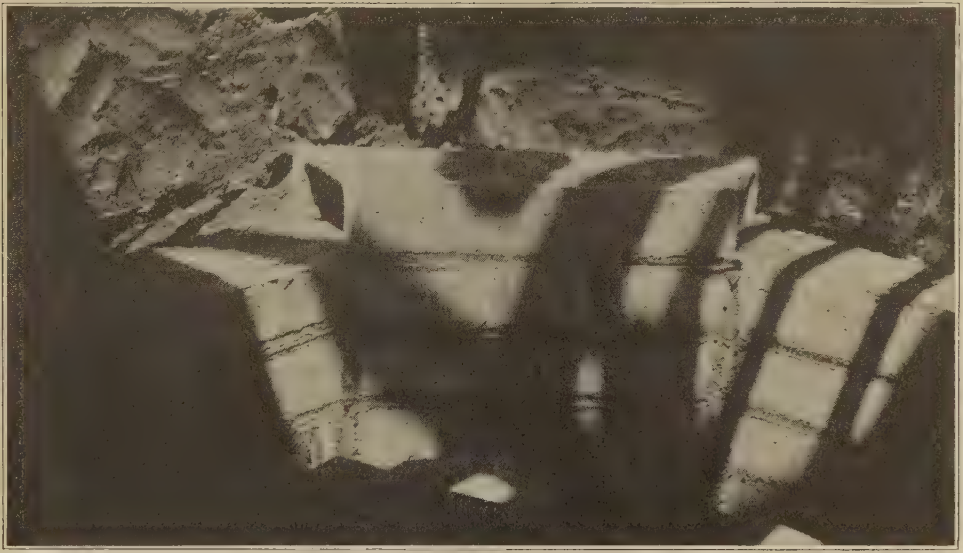
Possibilities in Other Fields

The reproduction of rock formations in concrete is by no means limited to animal den construction. The fact that color, strata and formations of rock can be reproduced makes possible many artistic features in landscaping and beautifying parks, lawns and gardens where natural rock is hard to get or the project is of such a nature that it presents an expensive construction problem.

Concrete Slabs for Manhole Construction

Pittsburgh Utility Company Trying Out Units Developed and Manufactured by the General Cement Products Corporation of That City

MANUFACTURE of a unique concrete product—a precast slab for use in building manholes in underground conduit lines—was undertaken recently by the General Cement Products Corporation of Pittsburgh. The unit or, rather, the series of units was suggested by an engineer employed by a Pittsburgh utility company and developed by the engineering department of the General Cement Products Corporation.



View showing shape of typical concrete slab for manhole construction

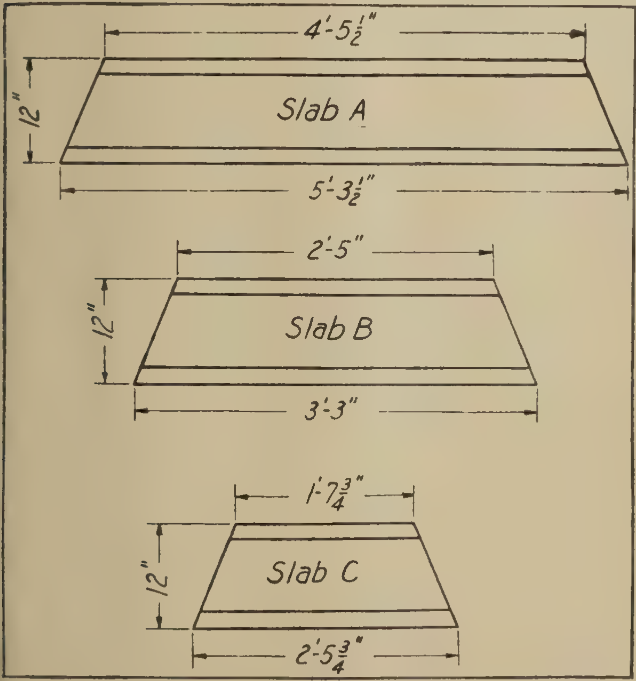


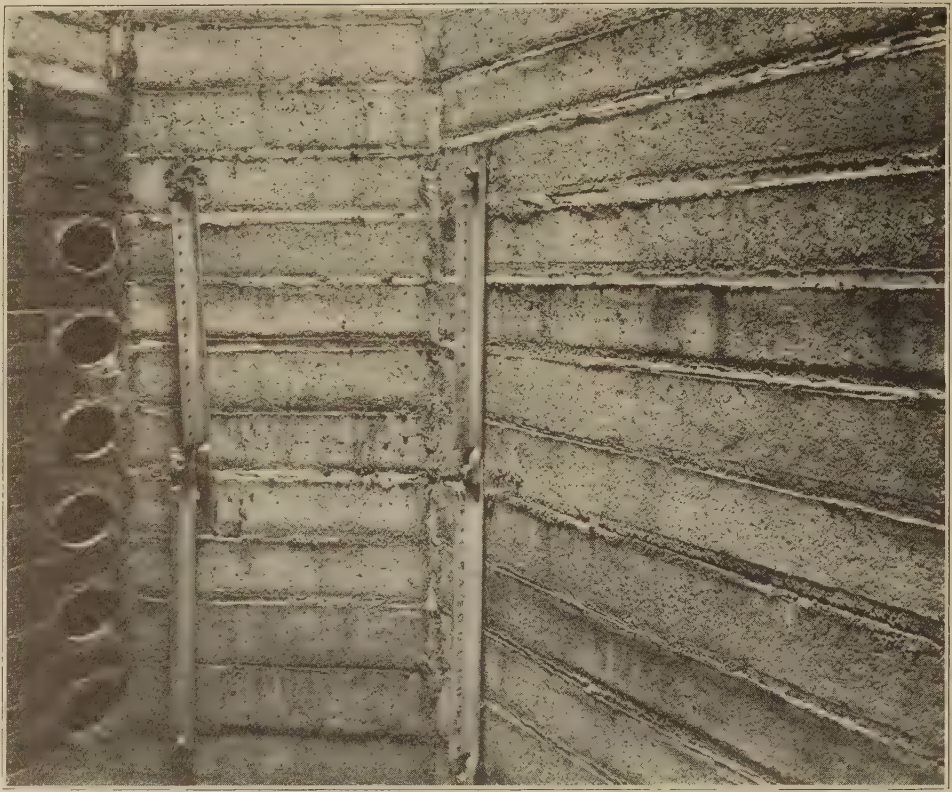
Figure 1. Plan views of concrete slabs "A," "B," and "C"

In the interest of greater economy without sacrifice of structural qualities, a Pittsburgh utility company is trying out these simple, unique slabs for building manholes in connection with its conduit lines. Such underground structures differ considerably in design and size from ordinary manholes.

Three Slab Designs

The slabs are designed so that it is easy to build any one of three types of manholes specified for such underground work in Pittsburgh. These are known as "two-way," "three-way," and "four-way" manholes. In building these structures only three sizes of slabs are required, these being designated as "A," "B" and "C." (See Figure 1.)

Each of the three types of slabs is channel-shaped, as shown in Figure 2, and the cross-sections are identical. The slabs are 6¼ in. high and 12 in. wide. When they are laid, as is shown in accompanying photographs, which is the standard practice for this type of construction, a hollow wall 12 in. thick is formed. The side and top walls of each slab are approximately 1½ in. in thickness. The inside face of "A" units is 4 ft. 5½ in. long, while the outside face is 5 ft. 3½ in. long; "B" slabs, 2 ft. 5 in. long on the inside and 3 ft. 3 in. long on the outside, and "C" units, 1 ft. 7¾ in. long on the inside and 2 ft.



Concrete slab manhole for conduit lines. Note metal hangers for stringing conduits

5¾ in. on the outside.

In the "two-way" type of manhole, two "A," four "B" and two "C" slabs are required for each course or, in other words, for each 6 in. of height. (See Figure 3.) When a "three-way" manhole is built, three "A," two "B" and three "C" slabs combine to form one course, as is illustrated in Figure 4. In the "four-way" manhole, each course consists of four "A" and four "C" slabs. (See Figure 5.) These combinations produce the structures that are generally required, but it is easily possible, of course, to build different sized manholes by making other combinations of the slabs. For example, a smaller "four-way" manhole can be built by using four "B" and four "C" slabs in each course, eliminating the "A" slabs which are shown in Figure 5. Or, by combining eight "C" units in each course, the structure may be made still smaller. Likewise, "three-way" or "two-way" manholes can be made smaller and sometimes larger by using different combinations of slabs.

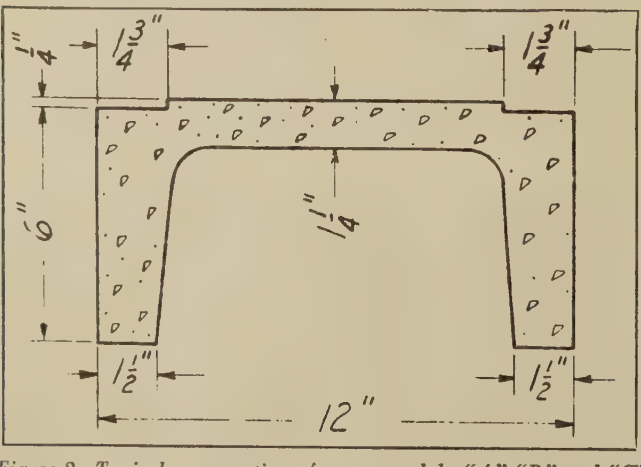


Figure 2. Typical cross-section of concrete slabs "A," "B," and "C"

Openings in manholes of this type are made by leaving out courses of "C" slabs and placing the conduits where they are required, filling in around them with monolithic

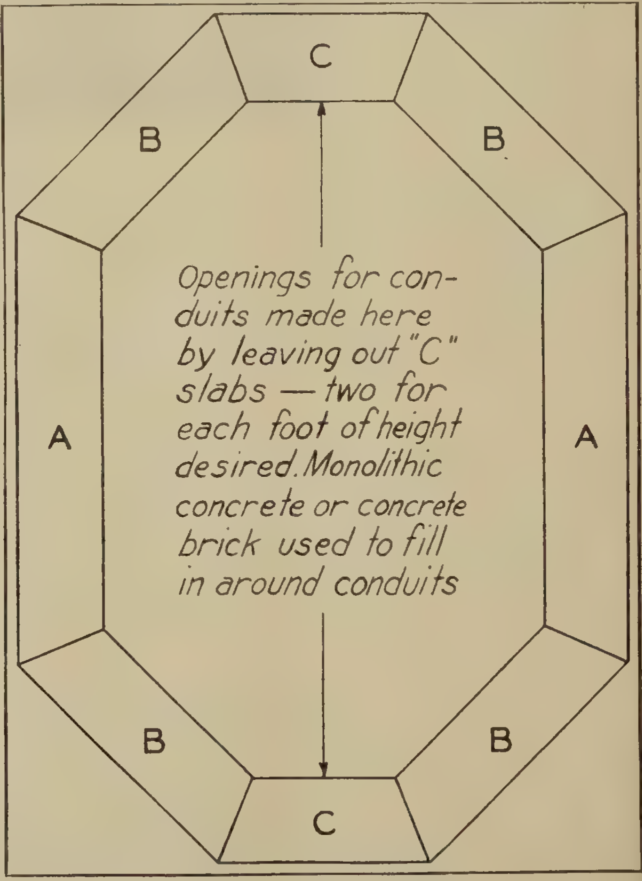

C
B
B
Openings for conduits made here by leaving out "C" slabs — two for each foot of height desired. Monolithic concrete or concrete brick used to fill in around conduits
A
A
B
B
C

Figure 3. Plan of "two-way" manhole, requiring two "A," four "B," and two "C" slabs for each course

concrete or brick as the structure is built up. Accompanying illustrations show courses of concrete slabs and brickwork around conduits, with subsequent courses of "C" slabs placed above the brick. Metal hangers are used to string cables around the inside walls of the manhole. These hangers are securely fastened by means of bolts which are embedded in mortar, between the precast side wall units.

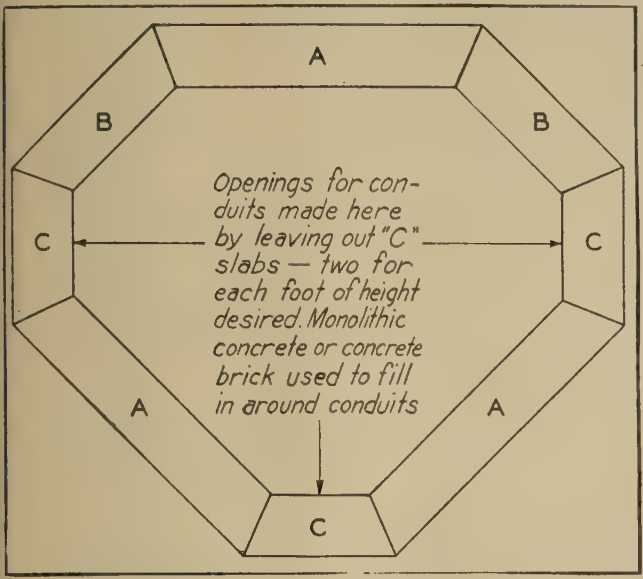

A
B
B
C
C
A
A
C
Openings for conduits made here by leaving out "C" slabs — two for each foot of height desired. Monolithic concrete or concrete brick used to fill in around conduits

Figure 4. Plan of "three-way" concrete slab manhole, each course of which requires three "A," two "B" and three "C" slabs.

In building manholes of this type the excavation is made in the usual manner, sheeting being used if required. Concrete is placed in the bottom and allowed to harden, thus forming a permanent, rigid base for the walls of concrete slabs. A chain-hoist or similar means is usually used to lower slabs and mortar into the hole. Two men are required to work below ground, while two more work at ground level, supplying slabs and mortar to the men below. The crew required for building concrete slab manholes, then, usually consists of four men, whereas eight or more frequently made up the bricklaying crew used heretofore to build such underground structures.

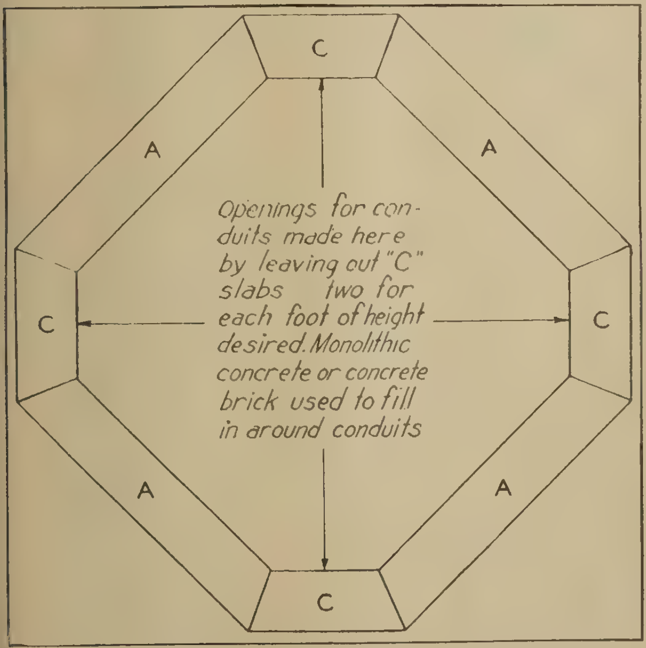

C
A
A
C
C
A
A
C
Openings for conduits made here by leaving out "C" slabs two for each foot of height desired. Monolithic concrete or concrete brick used to fill in around conduits

Figure 5. Plan of "four-way" manhole, requiring four "A" and four "C" concrete slabs in each course

At present, an engineer for a Pittsburgh utility company is investigating this type of construction to obtain cost data. However, there is evidence of appreciable economy at the outset in that the number of workmen in the manhole-building-crew can be reduced by 50 per cent.

Aggregates used in manufacturing the slabs are slag, sand, and limestone screenings, combined to give proper workability and maximum strength in a 1:6 mix that is proportioned by weight. The slabs are made by the wet cast process in wooden molds, the concrete being vibrated by means of an eccentric shaft which supports the mold box. It is understood that the General Cement Products Corporation has patents pending on this vibrating method of compacting the concrete. The slabs are cured at least 48 hours in the same steam rooms this Pittsburgh plant uses for curing its concrete building products. In addition, the slabs are allowed to air-cure for several days before they are delivered upon construction work.

Research on Reaction of Water on Calcium Aluminates

The Bureau of Standards has been engaged in looking into the subject of the reaction of water on the calcium aluminates and a brief item concerning the result appears below.

In this investigation the four calcium aluminates ($CaO.Al_2O_3$, $3CaO.5Al_2O_3$, $5CaO.3Al_2O_3$, $3CaO.Al_2O_3$) were made, and the mechanism of their reaction with water was studied. Tricalcium aluminate, which appears to be the only aluminate present in portland cement of normal composition and normal properties, reacts so rapidly with water that the changes in composition of resulting solutions could not be followed. The monocalcium aluminate and the 3:5 calcium aluminate occur in cements characterized by a high alumina content. These two aluminates, together with the 5:3 calcium aluminate and a high alumina cement, react with water to form metastable and supersaturated monocalcium aluminate solutions in the early periods. The metastable solutions decompose as the reaction proceeds with the precipitation of varying amounts of hydrated alumina and crystalline hydrated tricalcium aluminates with attendant increases in both the pH and molar ratio CaO/Al_2O_3 in the resultant solutions. If the metastable solutions are filtered from the reaction mixtures, they also decompose with the precipitation of the above phases.

A study of the subsequent changes in the aluminate solutions attended by increasing concentrations of calcium hydroxide, a product of the hydrolysis of the calcium silicates, shows that the alumina is almost completely precipitated from solution at a pH value of 12.0 or above.

The constitution of the aluminate solutions is discussed. Calculations based upon the electrometric measurements and chemical analyses indicate that the alumina in the aluminate solutions is in combination with lime as the calcium salt of monobasic aluminic acid.

Tricalcium silicate and beta dicalcium silicate appear to hydrolize less in an aluminate solution than in water.

An electrometric titration study of aluminum chloride and calcium hydroxide is described. The conditions under which the aluminum precipitates as the hydroxide and as the calcium chloraluminate were studied. The formation of calcium chloraluminates from the reaction of calcium chloride with aluminate solutions is also described. The optical properties of the various hydration products are given.

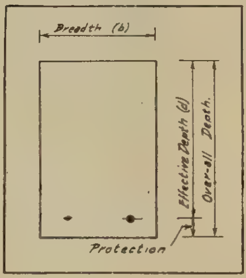
Reinforced Concrete Design Simplified

Chart A′—Large Beams Reinforced for Tension
Chart B′—Large Beam Dead-Load Information
and
Some Informal Comments by the Author

By PROF. JAMES R. GRIFFITH
Professor of Structural Engineering, Oregon State Agricultural College, Corvallis, Ore.

Joint Committee Specifications

$f'_c =$ 2,000 lbs. per sq. in.
$f_c =$ 800 lbs. per sq. in.
$f_s =$ 18,000 lbs. per sq. in.
$n = 15$
Dead-Load Weight = 150 lbs. per cu. ft.



TWO charts, A′ and B′, are presented in this issue as addenda, but not as finis. In the February, 1928, issue of CONCRETE, announcement was made of this series of articles. The announced series was completed in last month's issue. The germ of an idea, as a new species is conceived, arising out of space. Slow in hatching, but once under way, growing with tremendous momentum. Far from being mature, it is still growing.

Presenting such a series appeals to me very much as the microphone must appeal to the radio entertainer. Without response such presentations are difficult. Although a frequent radio listener, I have never yet written to a radio station commending or criticizing its broadcast. No doubt many readers of this series have likewise left unsaid both favorable and unfavorable comments. But let me take this opportunity to thank the numerous readers from all parts of the country, and even from England, who have expressed themselves. Without constructive criticism we cannot improve. The many favorable comments have lightened the task.

Some Comments

Many members of the profession have expressed their appreciation of the charts as time-savers. Teachers, designers, consulting engineers, sales engineers, architects, and contractors have repeatedly written for reprints. Particularly heavy has been the demand for the charts reprinted on durable paper for constant use. It is planned to satisfy that demand in the very near future.

Several complaints have come in that Charts A and B were not made to include large enough beam sizes. To meet that demand I am presenting Charts A′ and B′ in this issue. While such large sizes are unusual and the charts difficult for close reading in these ranges, they will no doubt be an aid in estimating and checking.

One industrial engineer, a very close friend of mine, recently criticized the charts as being too mechanical and taking the brain work out of design. He remarked that he preferred "the good old strong-arm methods of computation." Yet he had just completed an analysis and survey of an industry which was not realizing the profits expected. His complete reports demonstrated whereby this organization could save over one hundred thousand dollars a year by installing modern methods of manufacture and mechanical conveying equipment. He had proven quite conclusively that old methods of manufacture and strong arm methods of conveying were inefficient. I am personally surprised that he is modern enough to use a slide rule. Paper and pencils are cheap.

New Charts for A. C. I. Code Planned

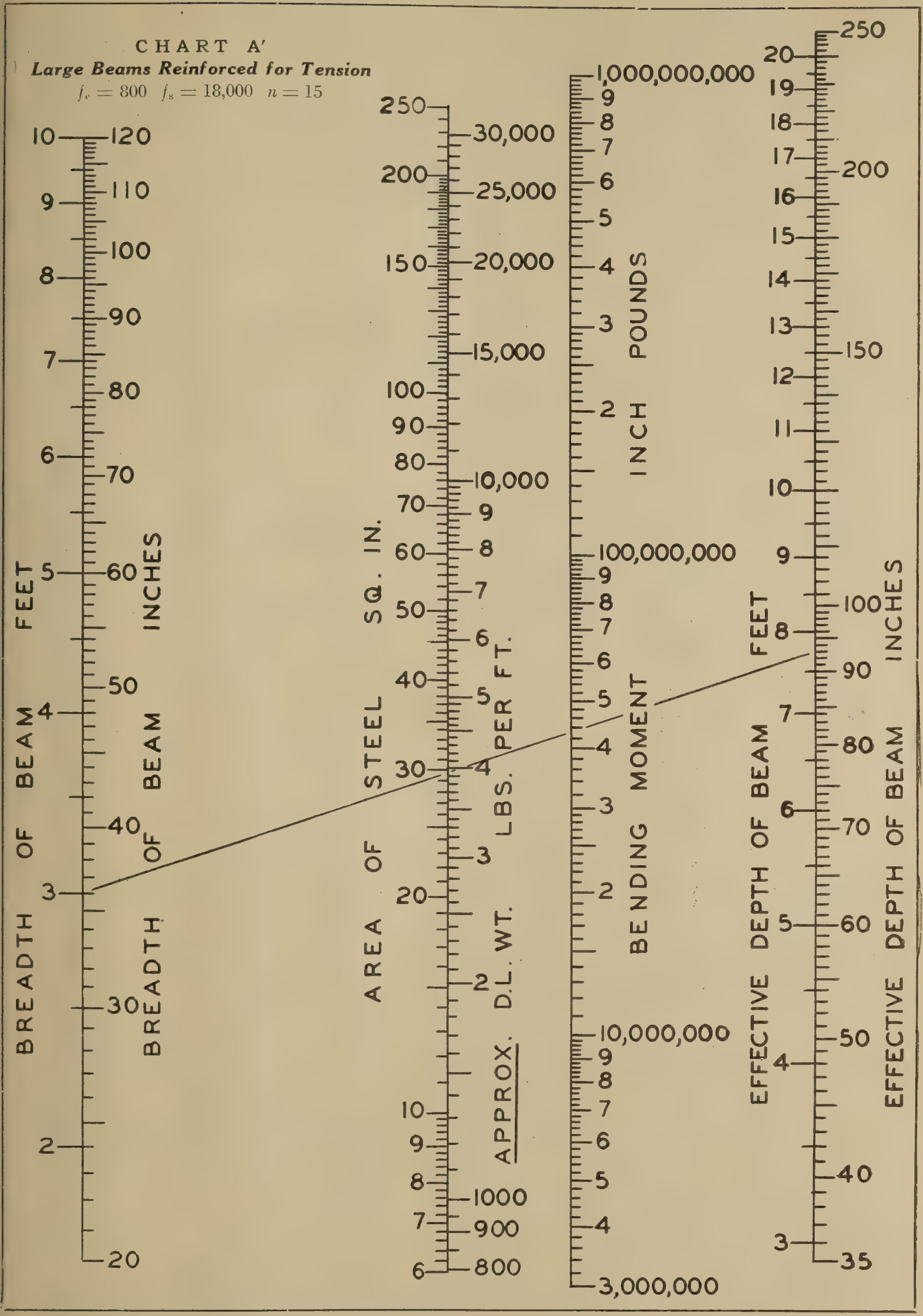
When it was first planned to present this past series of charts, careful consideration was given to the specifications and stress limitations in use by the greater number of readers. Since that time, a new code has been presented by the American Concrete Institute. This code, recommending larger unit stresses and some fundamental changes, has met with a very favorable reception. Its acceptance has reached the point where it is now felt worth while to add the necessary charts to include the changes of the A. C. I. code. At a conference for discussion of the proposed new charts and their stress limitations, it was asked if the charts could not be made so that any unit concrete stress would be applicable. While not impossible, I consider this plan as being very impractical. Simplicity would be sacrificed. Complicate a chart and its usefulness is decreased. The designer is usually working with one definite group of stresses and I believe he would prefer several sets of charts and maximum simplicity.

Beginning with the next issue a series of charts will be

CHART A'

Large Beams Reinforced for Tension

$f_c = 800 \quad f_s = 18{,}000 \quad n = 15$



presented for the convenience of the users of the new A. C. I. code. The unit steel stress (f_s) will be taken as 20,000 lbs. per sq. in. The ultimate compressive stress in the concrete (f'_c) will be taken as 2,000 and 2,500 lbs. per sq. in. for beams and slabs, 2,000 and 3,000 lbs. per sq. in. for columns. This will necessitate similar charts for each limiting stress but is considered as worth while. It is planned to then take the same problems, when possible, as used in the original series for comparisons of economy.

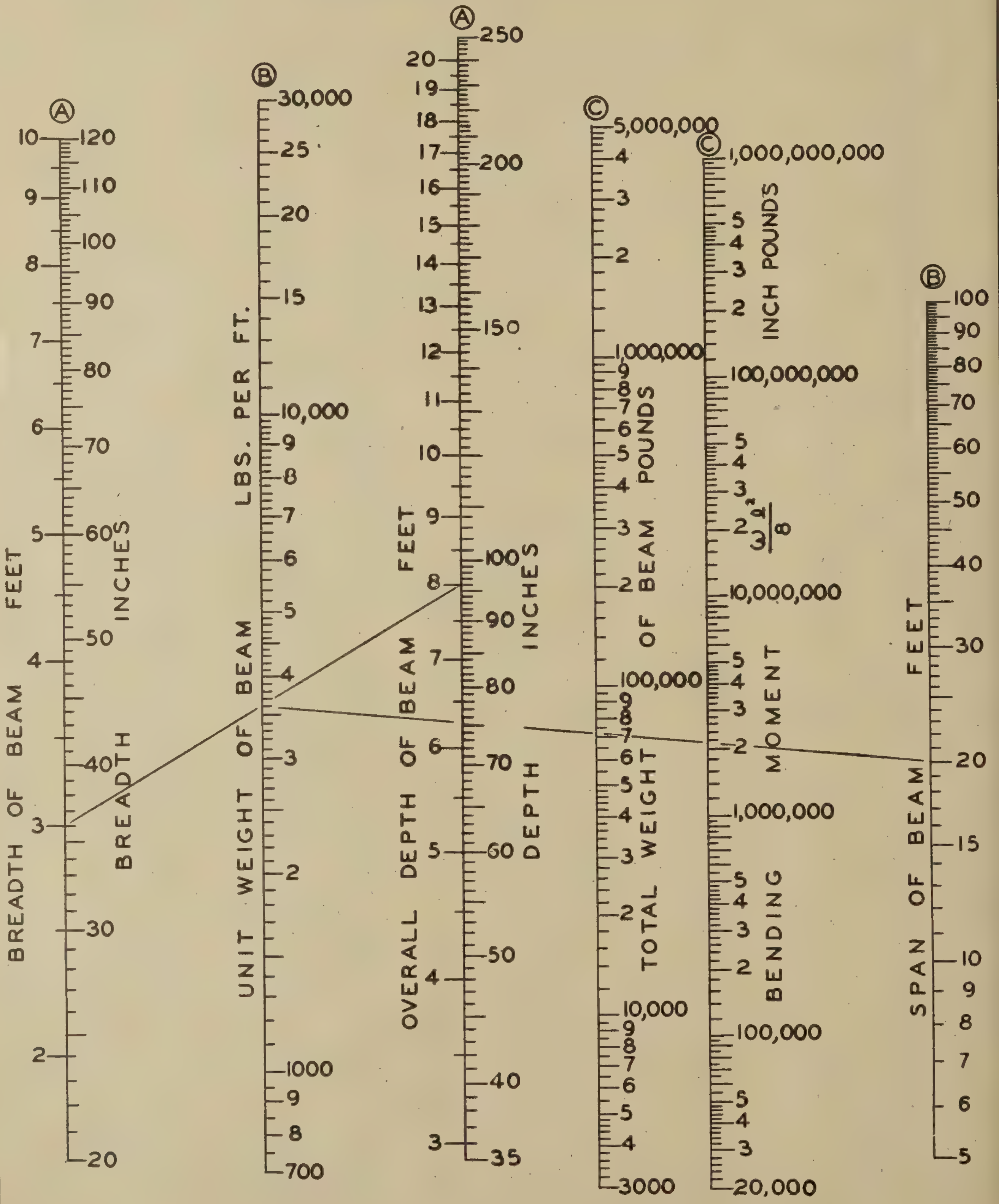


CHART B′

Large Beam Dead-Load Information

Weight of concrete = 150 lbs. per sq. ft.

Application of Charts A′ and B′

The only changes made from Charts A and B are in size limitations. Scales and spacings are identical in the originals. One slight change was made in estimating the amount of protection below the steel, the total depth being taken as $9d/8$ in Chart A′ for figuring the approximate weight of the beam. Due to the larger beam sizes I have shown the beam dimensions in feet as well as inches.

Solutions will be made as originally described. The isopleth on Chart A′ shows the investigation of a beam for the following conditions:

Effective depth = 93 inches,
Overall depth = 8 feet,
Breadth = 3 feet.

giving the following results:

Resisting moment = 43,000,000 in. lbs.,
Tensile reinforcing = 29.8 sq. in.,
Approx. D. L. weight = 3,950 lbs. per ft.

The isopleths on Chart B′ give for this same beam with a simple span of 20 feet the following information:

D. L. weight = 3,600 lbs. per ft.,
Total weight of beam = 72,000 lbs.,
D. L. bending moment = 2,150,000 in. lbs.

By slide rule the following results were obtained:

$A_s = 0.0089 \times 36 \times 93 = 29.8$ sq. in.,
$M = 138.7 \times 36 \times 93^2 = 42{,}800{,}000$ in. lbs.,
D. L. weight $= 3 \times 8 \times 150 = 3{,}600$ lbs. per ft.,
Total wt. of beam $= 3600 \times 20 = 72{,}000$ lbs.,

$$\text{D. L. moment} = \frac{3600 \times 20^2 \times 12}{8} = 2{,}162{,}000 \text{ in. lbs.}$$

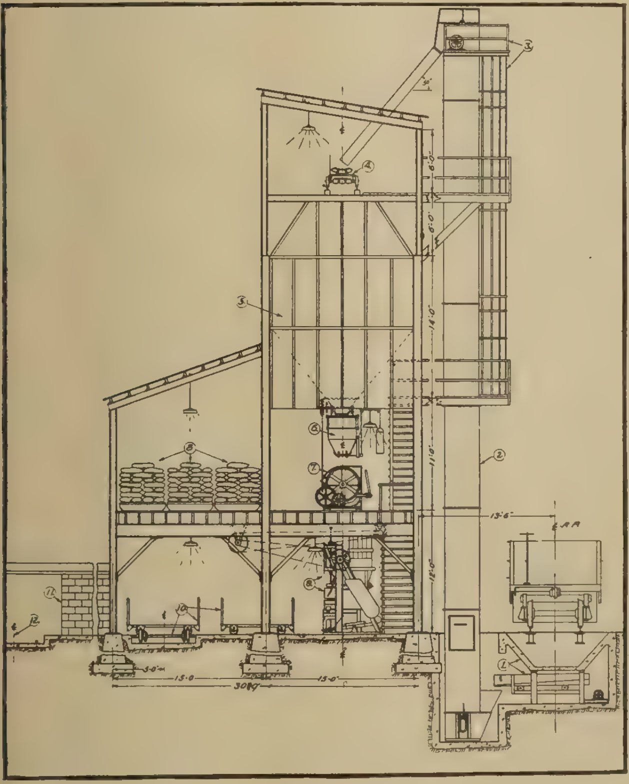
A Five-Machine Products Plant Layout

A Suggested Gravity Type Products Plant Design

MANUFACTURERS of equipment for concrete products plants have done much to influence products plant design along efficient and economical lines. In fact, a feature of their service to purchasers of equipment has been to aid them in installing the machinery to good advantage.

An accompanying illustration shows a cross section of a gravity, 5-machine plant suggested by the engineering department of the Consolidated Concrete Machinery Corporation.

The following engineering data refer by number to the numbers indicated on the drawing:



No. 1

A reciprocating elevator feeder of the type used to unload hopper bottom railroad cars. This feeder is placed beneath a small hopper, which is desirable so that there is a certain amount of storage in the hopper while the railroad car is being jacked up from one hopper to the next. The feeder operates to the best advantage when driven by an independent 3 H. P. normal torque motor with a push button control. The control of this motor must be interlocked with the elevator motor. This interlocking feature prevents the starting of the feeder until the elevator is in motion. It also stops the feeder in case the elevator motor should stop, thereby preventing clogging of the elevator boot.

No. 2

A totally enclosed direct driven bucket elevator having a capacity of sixty tons per hour. The continuous type bucket elevator is strongly recommended both from the standpoint of capacity and economy.

Elevator specifications: Head shaft should be 3 7/16 in., countershaft 2 7/16 in. and footshaft 2 7/16 in., with style D takeup.

A 10 H. P. high torque motor, 1,150 r.p.m. with a push button control is required to operate this elevator. As explained above, the control of this motor should be interlocked with the control of the feeder control.

Center sections of elevator casing should be constructed of No. 12 Keystone copper steel reinforced on all corners with 2x2x¼ in. angles riveted with ⅜ in. rivets pneumatically driven. Sections should not be longer than 10 ft. for easy installation.

Bucket chain should be No. 111 special combination steel and malleable chain with attachments every second link. This No. 111 chain has an ultimate strength of 3,600 lbs.

Buckets should be 14x8 in., 10 gauge Keystone copper steel, each bucket fastened to chain through four ⅜ in. by 1 in. machine bolts and lock washers.

No. 3

A safety ladder and inspection platform which should be furnished with the elevator. The safety ladder is nothing more than a steel ladder enclosed in a steel basket to prevent a workman from falling to the ground. The safety ladder provides a means of getting to the top of the bins or on top of the inspection platform of the elevator for oiling and greasing purposes.

No. 4

A shuttle belt conveyor. This belt conveyor is mounted on a steel frame which in turn is mounted on three pairs of narrow gauge car wheels, making a portable conveyor, which is moved back and forth by means of a hand ratchet. The conveyor should be equipped with a 3 H. P. reversible, 1,150 r.p.m. normal torque motor. The purpose of this conveyor is to take the material as it comes from the elevator and distribute it to the various bins; this is done by simply moving the belt conveyor so that the end of the belt comes over the bin to be filled.

No. 5

Is the overhead storage bin proper? As shown, it has a storage capacity of approximately 150 tons for each block machine, i. e., 75 tons of sand and 75 tons of gravel. This storage capacity is desirable so that a carload of material can be dumped into a bin at one time without first waiting for the bin to be completely emptied.

No. 6

A standard pair (one sand batcher and one gravel batcher) of volume measuring batchers. The purpose of these batchers is to automatically measure and proportion by volume the amount of sand and gravel for each mix. While this is the main feature of measuring batchers, still as equally important is the quick charging of a large size mixer such as is being used today. A 21 cu. ft. or a 42 cu. ft. batch mixer can be charged with sand and gravel in less than five seconds, thereby cutting down the charging time to a minimum and permitting the maximum time for the actual mixing.

No. 7

A 21 cu. ft. capacity direct driven batch mixer. A 21 cu. ft. mixer is specified, because it is impossible to thoroughly mix enough concrete for a consolidated production machine with less than a 21 cu. ft. capacity mixer. A great many places are installing two 21 cu. ft. or one 42 cu. ft. mixer in order to give a thorough mix and to have enough mixer capacity to allow for small hold-ups as are bound to occur in any plant.

No. 8

An economical method of cement storage and handling. The cement is elevated from the railroad car either by belt conveyor or a vertical bag elevator, not shown on this layout. However, room has been provided for these elevators in several locations. The cement is taken from the cement elevator and loaded on a lift truck platform. When the cement is needed, thirty sacks can be brought right up behind the mixer, making it readily available for the mixer man. Thirty sacks can be conveniently loaded on each platform, making sufficient cement storage behind each mixer. This is ample storage so that the space back of one mixer may be left open for a sack cleaner and baler.

No. 9

A power stripper.

No. 10

An empty car on the transfer car and an empty car on one of the stub tracks ready to be loaded. It will be noticed that provision is made on this layout for two stub tracks to each block machine. This is an essential production requirement as it makes possible the continual operation of the machine throughout the entire day. As soon as one car is loaded, the operator starts loading the other. In the meantime, the transfer man removes the loaded car, replaces it with an empty and makes it ready for the operator to start loading.

No. 11

The relative location of the curing rooms.

No. 12

Is the outside or yard transfer track, which is closed in throughout the extent of the curing rooms.

A. G. C. Figures Show Decline in July Building

The volume of construction job activities during July declined both from the previous month and from the index level of the same month last year, according to a statistical study just completed by the Associated General Contractors of America. This is interpreted as an indication that the rate of activities on projects under way, as measured by volume of shipments of construction materials, is beginning to reflect the decline in the volume of contract awards which has been in evidence during most of this year.

The index figure for job activities during July was found to be 218 as compared with 231 in June and 238 in July last year.

This is explained by the activities on uncompleted projects for which contracts were awarded last year. The heavy volume of carried over commitments began to be cleared up in May this year and current activities are proceeding at the new levels dictated by the lower volume of contract awards.

The situation is not deemed critical by the contractor's association since most of the decline has occurred in the speculative type of residential construction, which is declared to have been proceeding at an inflated rate in previous years. Recession in this type of building is deemed to be beneficial and it is anticipated that once the flow of funds turns from the stock market to other channels that sound investment construction will again proceed.

Building construction, according to reports made to S. W. Straus & Co., on the basis of plans filed or permits issued in 577 comparable cities in the United States, indicates a loss of 13 per cent in July over the same month a year ago.

The total volume of construction planned was $289,156,107, as against $332,312,452 in July last year, and $265,564,649 in June this year. These cities, however, according to the Straus reports made a gain of 9 per cent over June of this year, indicating a slightly upward tendency.

Trade Conference for Concrete Mixer Industry

The Federal Trade Commission has authorized the holding of a trade practice conference for the concrete mixers and pavers industry of the United States. The full text of the commissioner's statement follows:—

Applicants for the conference represent, from the standpoint of output, approximately 95 per cent of the mixers and pavers industry. They expressed a desire to hold a conference and formulate appropriate rules of business conduct with the view to correcting alleged irregularities in their trade.

Among subjects proposed for discussion are: inducing violations of contracts, misrepresentation of the size, weight and capacity of their mixers and pavers, or making false statements of the same character concerning the mixers and pavers manufactured by competitors; granting of secret rebates; price discrimination; methods of handling trade-ins and granting of selling commissions to others than established dealers.

Design of a Concrete Mixture

A Half-Calculation, Half-Trial Method for Designing Water-Cement Ratio Concrete Mixtures, Based on the Expanded Voids of the Aggregates

By R. P. V. MARQUARDSEN
Assistant Engineer, Chicago Terminal Improvement, Illinois Central Railroad Company

Part II

The foregoing discussion neglected the effect of the "weighted" size of the cement. The effect of the "weighted" size of the cement is equivalent to an increase of $2c$ in the "weighted" size of the fine aggregate, c being the "weighted" size of the cement. This is illustrated in Figure 2, at (e).

The "weighted" size of the cement may be found in a manner similar to the one described for finding the "weighted" size of the fine aggregate. For all practical purposes, however, c may be taken equal to 0.0022 in. inasmuch as additional cement will have to be introduced in mixing the trial batch, anyhow.

Inasmuch as the volume ratio of concrete produced to loose coarse aggregate (neglecting the effect of the "weighted" size of the cement) is equal to $(1 + sr')^3$ for any grading of the two aggregates, the volume ratio of concrete produced to loose coarse aggregate (taking into account the effect of the "weighted" size of the cement) therefore will be equal to $[1 + (s + 2c)r']^3$ and the volume of concrete produced by a given volume of loose coarse aggregate, R, will be equal to $[1 + (s + 2c)r']^3R$.

But the volume of concrete produced less the absolute volume of the coarse aggregate is equal to the volume of the mortar, or

$$M = \{[1 + (s + 2c)r']^3 - A_r\}R \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

in which M is the least volume of mortar required to fill the expanded voids of a given volume of loose coarse aggregate, R, and A_r is the absolute volume factor of the loose coarse aggregate; i. e., the ratio of the absolute volume of the coarse aggregate to its loose volume.

FIG. 3

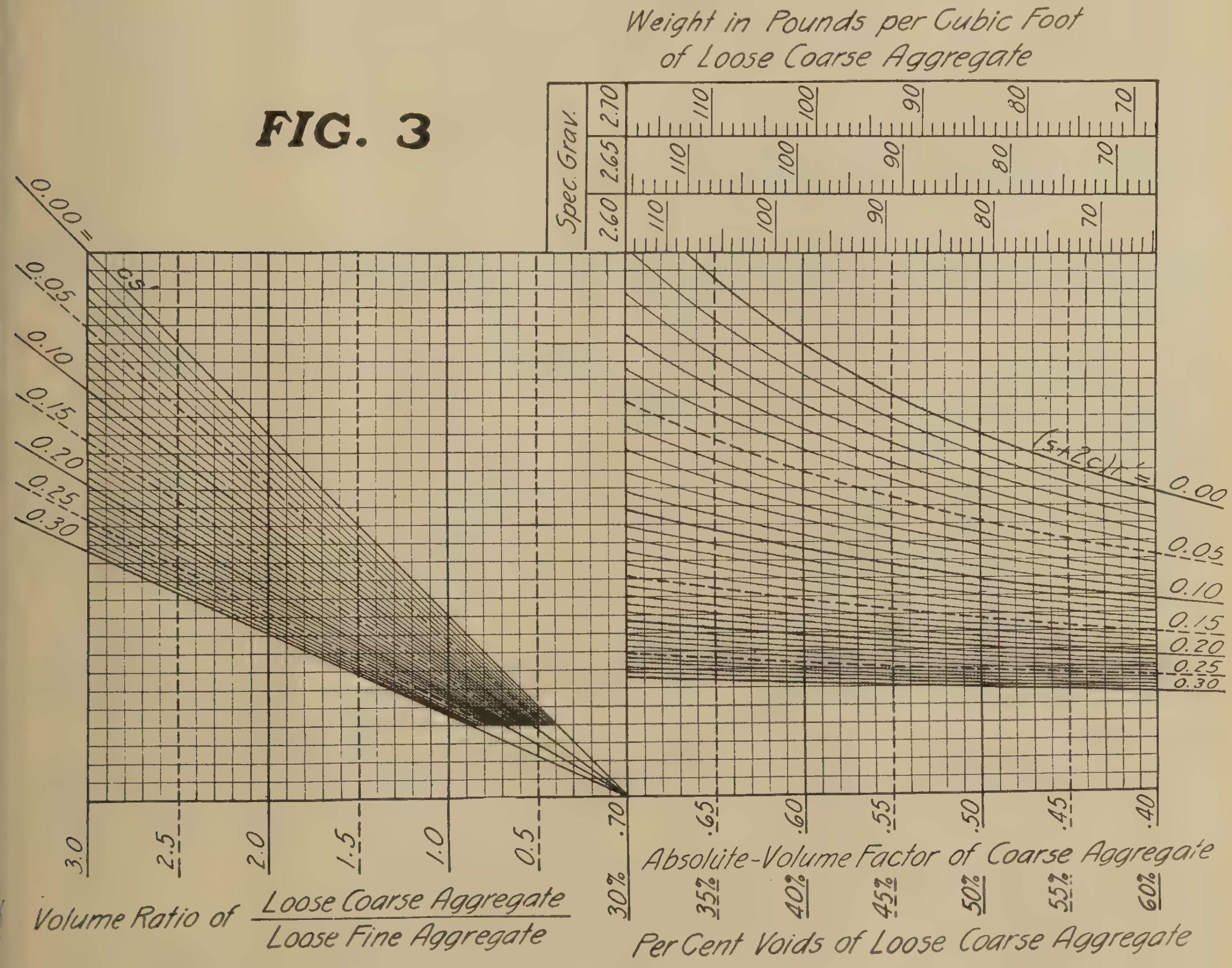
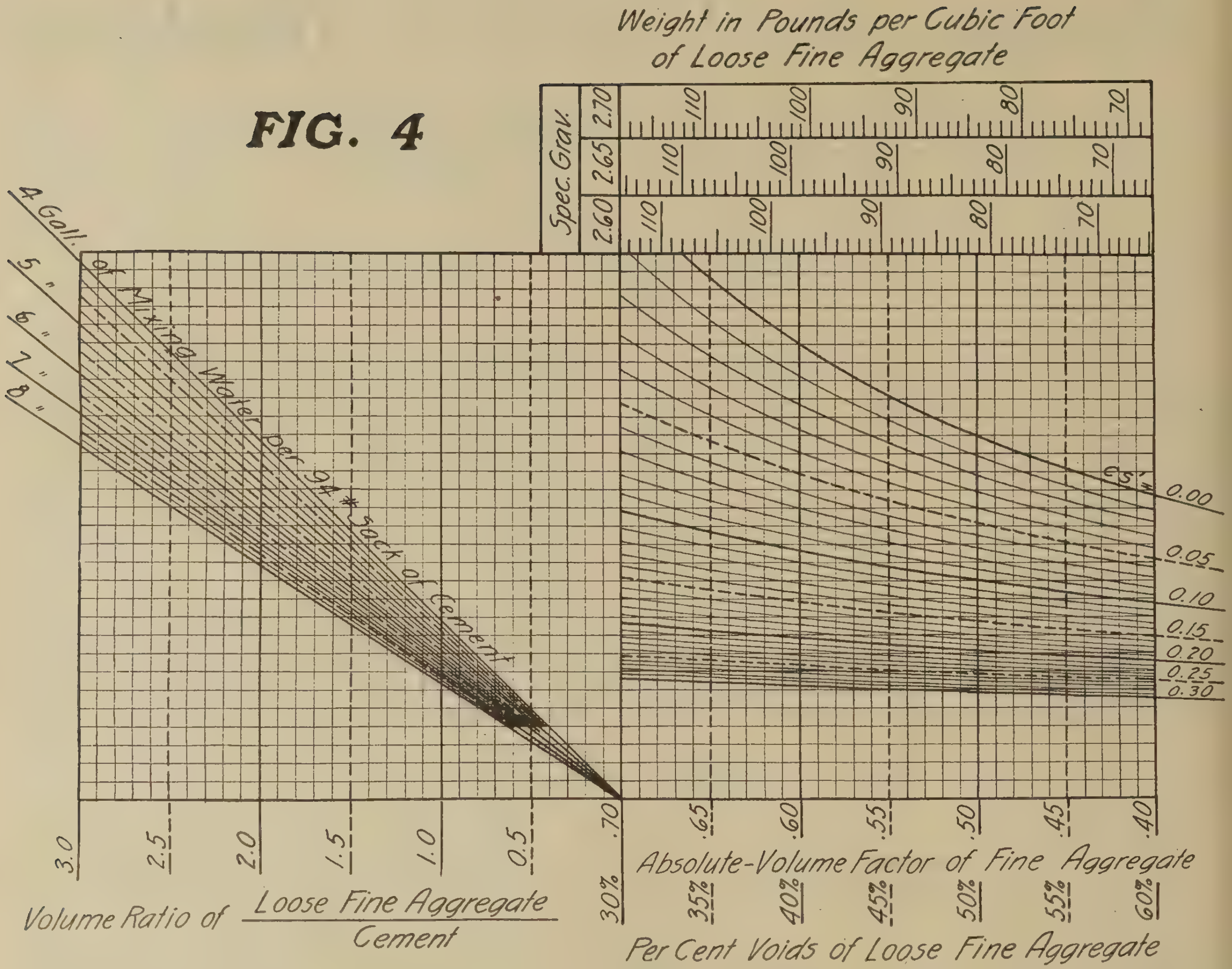


FIG. 4



By following the same line of reasoning, the volume ratio of mortar produced to loose fine aggregate will be found to be equal to $(1 + cs')^3$, in which c is the "weighted" size of the cement and s' is the "weighted" size reciprocal of the fine aggregate.

The "weighted" size reciprocal of the fine aggregate may be obtained in a manner similar to the ones described for finding the "weighted" size reciprocal of the coarse aggregate. In the following scheme, the multiplication method is used.

Typical Method for Establishing the Weighted Size Reciprocal of Fine Aggregate

Sieve No.	Per Cent of Fine Aggregate $= p$	Reciprocal of Av. Size of Particle ÷ 100 $= 1 \div 100s''$	$p(1 \div 100s'')$
Passing No. 100	2	2.28	4.56
No. 100-No. 50	10	1.14	11.40
No. 50-No. 30	20	0.57	11.40
No. 30-No. 16	25	0.28	7.00
No. 16-No. 8	30	0.14	4.20
No. 8-No. 4	10	0.071	0.71
No. 4-3/8-in.	3	0.035	0.11
Total = Weighted size reciprocal =			39.38

Inasmuch as the volume ratio of mortar to loose fine aggregate is equal to $(1 + cs')^3$, the value of M may also be expressed as follows:

$$M = (1 + cs')^3 S \qquad (2)$$

in which M is the volume of mortar produced by a given volume (standard measurement) of loose fine aggregate, S.

Equating formulas (1) and (2) and solving for the volume ratio of loose coarse aggregate to loose fine aggregate (standard measurement) we have

$$\frac{R}{S} = \frac{(1 + cs')^3}{[1 + (s + 2c)r']^3 - A_r} \qquad (3)$$

Paste Required and Ratio of Fine Aggregate to Cement

The volume of mortar produced less the absolute volume of the fine aggregate is equal to the volume of the paste, or

$$P = [(1 + cs')^3 - A_s]S \qquad (4)$$

in which P is the least volume of paste required to fill the expanded voids of a given volume of loose fine aggregate, S, and A_s is the absolute-volume factor of the loose fine aggregate; i. e., the ratio of the absolute volume of the fine aggregate to its loose volume.

But the volume of paste is also equal to the absolute volume of the cement plus the volume of the mixing water, so that, assuming a specific gravity of 3.1 for cement and expressing the mixing water in gallons per 94-lb. sack of cement, the value of P may also be expressed by the following formula:

$$P = (0.485 + 0.1337G)C \qquad (5)$$

in which P is the volume of paste produced by mixing a given volume of cement, C, with a given number of

U. S. gallons, G, of water per 94-lb. bag of cement.

Equating formulas (4) and (5) and solving for the volume ratio of loose fine aggregate to cement, the result is:

$$\frac{S}{C} = \frac{0.485 + 0.1337G}{(1 + cs')^3 - A_s} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (6)$$

This formula gives the maximum allowable volume ratio of loose fine aggregate to cement. The actual ratio to be used, depending on the quantity of additional paste introduced to obtain the desired workability, will be somewhat smaller.

Diagrams and Forms

Formula (3) gives the theoretical volume ratio of loose coarse aggregate to loose fine aggregate (standard measurement) when just enough paste is used to fill the expanded voids of the loose fine aggregate. By introducing additional paste to the trial batch in order to increase the workability of the concrete, the volume of the mortar is increased slightly. This means that less fine aggregate will be used for a given volume of mortar. Consequently if it is desired to retain the theoretical volume ratio of mortar to loose coarse aggregate (i. e., to use the least quantity of mortar required to fill the expanded voids of the loose coarse aggregate) the volume ratio of loose coarse aggregate to loose fine aggregate given by Formula (3) theoretically could be increased slightly. Inasmuch, however, as so many approximations are introduced in determining the average sizes and "weighted" values of the aggregates, such refinement would be a waste of time. It may be assumed, therefore, that it will be sufficiently accurate for all practical purposes to maintain the ratio of loose coarse aggregate to loose fine aggregate given by Formula (3) irrespective of the quantity of paste used.

But instead of actually applying Formula (3), the ratio of loose coarse aggregate to loose fine aggregate (standard measurement) may be taken directly from Figure 3, as follows:

Enter the diagram from the bottom (or top) of the right-hand half, at the absolute-volume or voids factor (or unit weight) of the coarse aggregate and proceed vertically upward (or downward) until the proper value of $(s + 2c)r'$ is encountered. From this point of intersection follow the horizontal line toward the left until the given value of cs' is encountered. The volume ratio of loose coarse aggregate to loose fine aggregate (standard measurement) is read at the bottom of the left-hand side of the diagram, vertically below this point.

In a similar manner the maximum allowable volume ratio of loose fine aggregate (standard measurement) to cement may be taken from Figure 4.

Strictly speaking, it will not be necessary to find the maximum allowable volume ratio of fine aggregate to cement in order to establish the mix required for a given workability, as the mix required may be found by mixing, with a given volume of paste, small quantities of fine and coarse aggregates (in the established ratio) until the desired workability is obtained. Proper allowance, of course, should be made to take care of the free water, or lack of absorption water, of the aggregates, so that the required ratio of mixing water to cement is maintained.

At times, however, it might be desirable to establish a mix based on the maximum allowable ratio of fine aggregate to cement before the final mix is established. Form A outlines the steps that are necessary if this procedure is followed.

Having established the proper mix by either of these two methods, the concrete yield per sack of cement may be taken directly from Figure 5.

Form "B" may be used in determining the free-water content (or the lack of absorption water, as the case may be) of the aggregates.

Concluding Remarks

The foregoing discussion is based on loose volumes of the aggregates. It seems to me that this is the most reasonable basis, inasmuch as good practice of today requires that the coarse aggregate should "float" in the mortar (rather than merely having its voids filled with mortar) and inasmuch as the ramming of concrete is no longer in style on account of prohibitive labor costs.

The formulas, diagrams, and forms will hold, however, should it be desired to obtain a mix based on dry-rodded volumes instead of on loose volumes, by merely substituting "dry-rodded" for "loose" throughout the discussion, but if the coarse aggregate consists of crushed rock, the

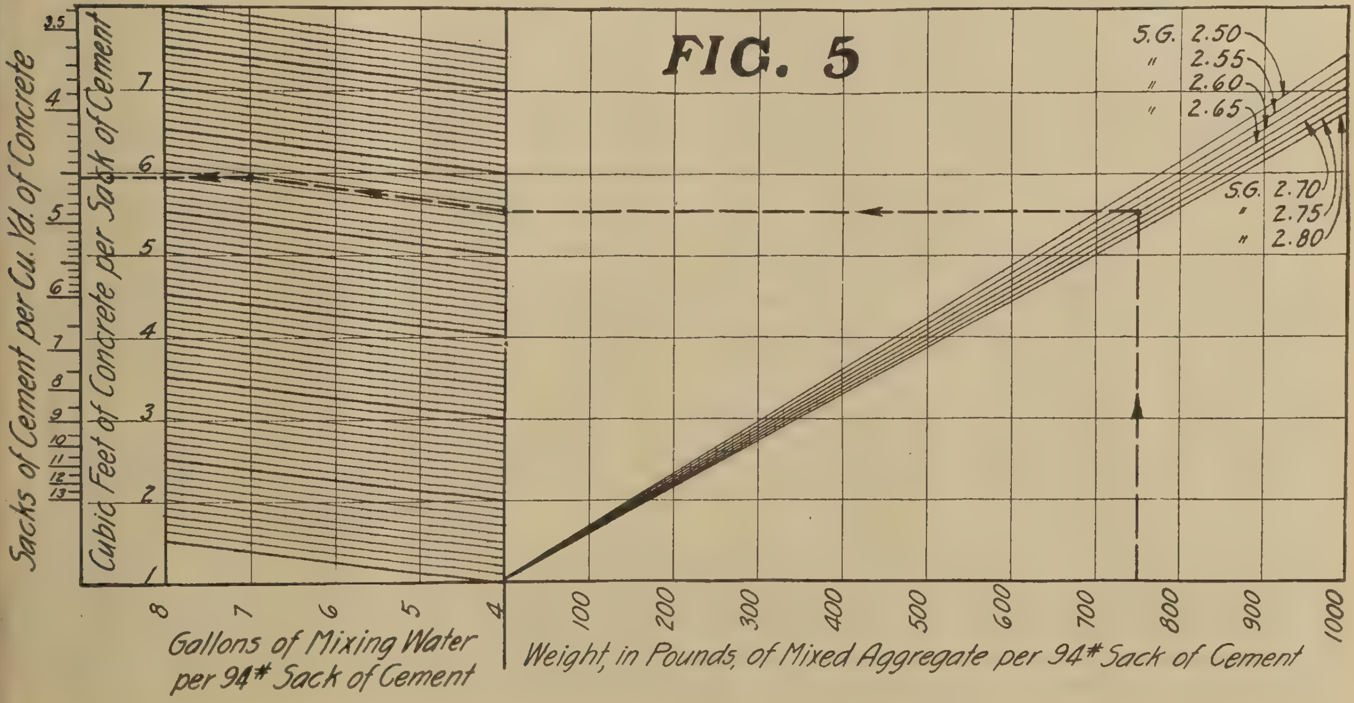
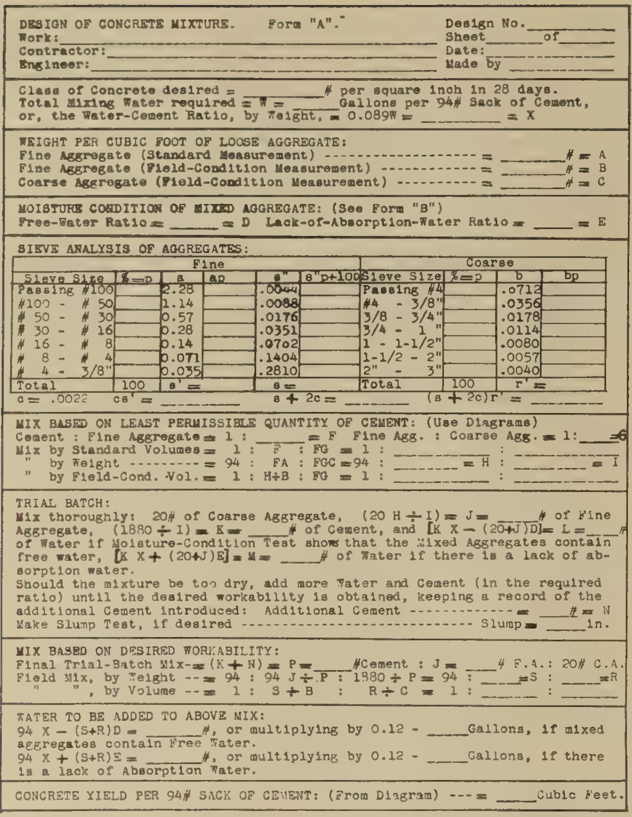


FIG. 5



DESIGN OF CONCRETE MIXTURE. Form "A". Design No.________
Work:______________________________ Sheet______of______
Contractor:________________________ Date:______________
Engineer:__________________________ Made by ___________

Class of Concrete desired = __________# per square inch in 28 days.
Total Mixing Water required = W = _____Gallons per 94# Sack of Cement,
or, the Water-Cement Ratio, by Weight, = 0.089W = __________ = X

WEIGHT PER CUBIC FOOT OF LOOSE AGGREGATE:
Fine Aggregate (Standard Measurement) ------------------- = ________# = A
Fine Aggregate (Field-Condition Measurement) ------------ = ________# = B
Coarse Aggregate (Field-Condition Measurement) ---------- = ________# = C

MOISTURE CONDITION OF MIXED AGGREGATE: (See Form "B")
Free-Water Ratio = ______ = D Lack-of-Absorption-Water Ratio = _____ = E

SIEVE ANALYSIS OF AGGREGATES:

Fine						Coarse			
Sieve Size	%=p	a	ap	s"	s"p+100	Sieve Size	%=p	b	bp
Passing #100		2.28		.0044		Passing #4		.0712	
#100 - # 50		1.14		.0088		#4 - 3/8"		.0356	
# 50 - # 30		0.57		.0176		3/8 - 3/4"		.0178	
# 30 - # 16		0.28		.0351		3/4 - 1 "		.0114	
# 16 - # 8		0.14		.0702		1 - 1-1/2"		.0080	
# 8 - # 4		0.071		.1404		1-1/2 - 2"		.0057	
# 4 - 3/8"		0.035		.2810		2" - 3"		.0040	
Total	100	s' =		s =		Total	100	r' =	

c = .0022 cs' = _________ s + 2c = ________ (s + 2c)r' = ________

MIX BASED ON LEAST PERMISSIBLE QUANTITY OF CEMENT: (Use Diagrams)
Cement : Fine Aggregate = 1 : ______ = F Fine Agg. : Coarse Agg. = 1:____=G
Mix by Standard Volumes = 1 : F : FG = 1 : __________ : __________
" by Weight --------- = 94 : FA : FGC = 94 : ________ = H : _________ = I
" by Field-Cond. Vol. = 1 : H÷B : FG = 1 : __________ : __________

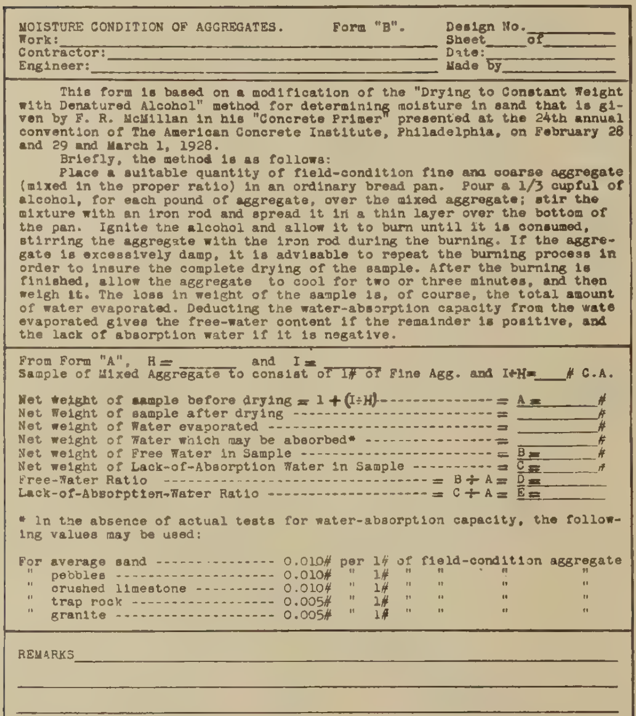
TRIAL BATCH:
Mix thoroughly: 20# of Coarse Aggregate, (20 H ÷ I) = J = _____# of Fine Aggregate, (1880 ÷ I) = K = _____# of Cement, and [K X − (20+J)D] = L = ___# of Water if Moisture-Condition Test shows that the Mixed Aggregates contain free water, [K X + (20+J)E] = M = _____# of Water if there is a lack of absorption water.
Should the mixture be too dry, add more Water and Cement (in the required ratio) until the desired workability is obtained, keeping a record of the additional Cement introduced: Additional Cement ------------- = ____# = N
Make Slump Test, if desired ---------------------------- Slump = _____in.

MIX BASED ON DESIRED WORKABILITY:
Final Trial-Batch Mix-= (K + N) = P = _____#Cement : J = ____# F.A.: 20# C.A.
Field Mix, by Weight -- = 94 : 94 J ÷ P : 1880 ÷ P = 94 : ____=S : _____=R
" " , by Volume -- = 1 : S ÷ B : R ÷ C = 1 : _______ : _______

WATER TO BE ADDED TO ABOVE MIX:
94 X − (S+R)D = _______#, or multiplying by 0.12 - _____Gallons, if mixed aggregates contain Free Water.
94 X + (S+R)E = _______#, or multiplying by 0.12 - _____Gallons, if there is a lack of Absorption Water.

CONCRETE YIELD PER 94# SACK OF CEMENT: (From Diagram) --- = _____Cubic Feet.

Form "A"



MOISTURE CONDITION OF AGGREGATES. Form "B". Design No.__________
Work:______________________________ Sheet_____of________
Contractor:________________________ Date:_______________
Engineer:__________________________ Made by_____________

This form is based on a modification of the "Drying to Constant Weight with Denatured Alcohol" method for determining moisture in sand that is given by F. R. McMillan in his "Concrete Primer" presented at the 24th annual convention of The American Concrete Institute, Philadelphia, on February 28 and 29 and March 1, 1928.

Briefly, the method is as follows:

Place a suitable quantity of field-condition fine and coarse aggregate (mixed in the proper ratio) in an ordinary bread pan. Pour a 1/3 cupful of alcohol, for each pound of aggregate, over the mixed aggregate; stir the mixture with an iron rod and spread it in a thin layer over the bottom of the pan. Ignite the alcohol and allow it to burn until it is consumed, stirring the aggregate with the iron rod during the burning. If the aggregate is excessively damp, it is advisable to repeat the burning process in order to insure the complete drying of the sample. After the burning is finished, allow the aggregate to cool for two or three minutes, and then weigh it. The loss in weight of the sample is, of course, the total amount of water evaporated. Deducting the water-absorption capacity from the wate evaporated gives the free-water content if the remainder is positive, and the lack of absorption water if it is negative.

From Form "A", H = _______ and I = _______
Sample of Mixed Aggregate to consist of 1# of Fine Agg. and I÷H=____# C.A.

Net weight of sample before drying = 1 + (I÷H)---------------- = A = ________#
Net Weight of sample after drying -------------------------- = ____________#
Net weight of Water evaporated ----------------------------- = ____________#
Net weight of Water which may be absorbed* ----------------- = ____________#
Net weight of Free Water in Sample ------------------------- = B = ________#
Net weight of Lack-of-Absorption Water in Sample ---------- = C = ________#
Free-Water Ratio ---------------------------------- = B ÷ A = D = ________
Lack-of-Absorption-Water Ratio -------------------- = C ÷ A = E = ________

* In the absence of actual tests for water-absorption capacity, the following values may be used:

For average sand --------------- 0.010# per 1# of field-condition aggregate
" pebbles ---------------------- 0.010# " 1# " " " "
" crushed limestone ------------ 0.010# " 1# " " " "
" trap rock -------------------- 0.005# " 1# " " " "
" granite ---------------------- 0.005# " 1# " " " "

REMARKS____

Form "B"

mix obtained by using dry-rodded volumes probably would not be as satisfactory as the mix obtained by using the loose-volume method.

It is possible that a more scientific method should be employed in determining the "average" sizes (and their reciprocals) of the aggregate particles than the one used in the discussion, viz., dividing by 2 the sum of the opening size of the two sieves designating a group, although the difference between the volume ratios obtained by such other method and the volume ratios obtained by the method given probably would be slight.

Diatomaceous Silica as Admixture in Concrete Studied

Properties of the diatomaceous silicas are being studied by the Bureau of Standards of the Department of Commerce as an aid in the development of specifications. Settling tests have been made on the representative samples according to one particular method of procedure which has been proposed. In this method 2 g. samples of the different materials are placed in graduated cylinders, and sufficient water is added to make a total volume of 100 ml. at 20 to 30 deg. C. The mixture is then shaken thoroughly, after which the cylinders are allowed to stand on a level space for 20 minutes and for 5 hours, respectively. The percentage of material in suspension in the 80 ml. nearest the top of the cylinders is then determined. The material in suspension in the top 80 ml. of water varied from 13.2 to 60.4 per cent at the end of 20 minutes and from 2.4 to 25.3 per cent at the end of 5 hours.

It was noted that the diatomaceous silica swelled when placed in lime water. A study of the volume of the resulting floc from the various representative samples may be an index of the fineness of subdivision and purity of the diatomaceous silica. It has been found that 2 g. of the various materials form flocs varying from about 12 to 35 ml. when placed in 100 ml. of saturated calcium hydroxide and allowed to settle 24 hours after an initial shaking of about 30 seconds. If the same procedure is followed, the measurements of the volume of the resulting floc from each diatomaceous silica may be checked to within 1 or 2 ml.

It has also been observed that diatomaceous silica will remove lime from a calcium hydroxide solution, from 1.15 g. CaO per liter (the approximate concentration of a saturated solution at 30 deg. C.) to about 0.07 g. CaO per liter. Increasing amounts of silica apparently do not further decrease this latter value. A study of the rate of this reaction has shown that different kinds of silicious materials decrease the concentration of the calcium hydroxide at different rates. The rate of the reaction has been measured by both chemical analyses of the resulting solutions and pH determinations with very good agreement.

It has been found possible to distinguish the purer grades of diatomaceous silicas (as determined from petrographic examination) from those containing considerable impurities by this method, but to date it has not been found possible to differentiate the purer grades, since the rate of decrease of concentration of the calcium hydroxide is so nearly the same with these latter materials. The time involved in obtaining these rates is too long to be of any value as a method for specifications.

States Improved 29,252 Miles of Highways Last Year

During 1928 the 48 States improved a total of 29,252 miles of their highway systems, according to figures received from the States and compiled by the Bureau of Public Roads of the United States Department of Agriculture. This is an increase of 2,530 miles over the 1927 figure of 26,722 miles.

Concrete for the Builder

AS you page through this month's Builder Section, you will see articles that show how some of your fellow concretors are making use of various kinds of advertising to increase their business. In them you will surely find a number of ideas that you can easily apply to your own activities with benefit.

It is our aim to collect a great many of these business building methods and to pass them on to our readers. Next month there will be more of them.

—‡—

REMEMBER that story in the June issue on filling stations? The other day a concrete products manufacturer who also is a builder told us that he is erecting a number of filling stations of the type illustrated. He said they looked so attractive that he clipped the page and took it to a prospective customer as a sales aid. And he landed the job. Now he is planning to dig up a couple of more jobs by going after the fellows who own vacant property at good filling station sites. That's not a bad idea, eh?

—‡—

OCTOBER 6th to 12th is Fire Prevention Week, during which newspapers, magazines, radio speakers, etc., will urge the public to help prevent fires.

This gives the concrete builder a fine opportunity to take advantage of the emphasis put on fire prevention by telling of the fire safety of concrete. Some special advertising effort, either in the newspapers or by direct mail, tying in with the Fire Prevention Week campaign, would be very effective. When it is known that every ***four minutes*** of every day of the year somebody's home burns and that the 1928 fire loss involved property destruction valued at $472,000,000 and caused 10,000 deaths, then it is not difficult to see that fireproof construction pays. Fire safety is a strong sales argument for concrete construction.

—‡—

ANOTHER article will cover the subject of methods of finishing concrete floors. This article will complete the series now running on concrete floors, but other articles on this subject will be published from time to time.

—‡—

THERE is no question but that there will be a great increase in the use of concrete floors in residences, stores and apartments. Their advantages are too evident to delay their use. From the standpoint of fire protection alone, a concrete floor earns its cost. And as you will see in next month's article, concrete floors can be finished and treated in such a way that they include every decorative possibility.

—‡—

IT may seem a little bit early these fine late summer days to be talking about winter work. But the other morning there was a touch of fall in the air and cold weather is not so far off that it is too early to begin making your plans for an active winter season this year.

There really is no reason for stopping construction work when cold weather comes. On the contrary, many contractors have found that the winter months can be as profitable as the summer months. One of the articles in next month's issue will tell why winter work is profitable and also give instructions for placing concrete during cold weather.

Better join the ever-growing group of contractors who have lengthened the construction season to include every month in the year.

Concrete for Permanence

Recommended Water-Cement Ratio and Curing

(Installment 4)

The Five Requirements for Durable Concrete. (Summarized from Installment No. 1 in the June issue):

1. **Durable, impervious aggregates.**
2. **A watertight binding medium—the hardened cement-water paste.**
3. **A mixture that permits complete incorporation of the aggregates in the paste.**
4. **Methods of mixing and placing to secure a uniform homogeneous mass.**
5. **Adequate protection and curing.**

IN the second and third installments, it was shown that the watertightness of the hardened cement-water paste is dependent on the water-cement ratio and the extent of the curing. It remains now to relate these factors in some way to the watertightness required to resist different degrees of exposure. Unfortunately, an exact relationship has not been established. Experience with structures in service and some laboratory data on permeability and artificial weathering tests (freezing and thawing), however, make it possible to suggest certain curing conditions and water ratios which may be relied on to give durable concrete under normal conditions where the other essential requirements of good concrete construction are satisfied.

RECOMMENDED WATER-CEMENT RATIOS FOR CONCRETE TO MEET DIFFERENT DEGREES OF EXPOSURE

These requirements are predicated on the use of concrete mixtures in which the cement meets the present standard specifications of the American Society for Testing Materials and to which an early curing is given that will be equivalent to that obtained when protected from the loss of moisture for at least 10 days at a temperature of 70 deg. F. Also that the concrete is of such consistency and is so placed that the space between the aggregate particles is completely filled with cement paste of the given water ratio.

Exposure / Class of Structure	Reinforced Piles, Thin Walls, Light Structural Members	Reinforced Reservoirs, Water Tanks, Pressure Pipes, Sewers, Canal Linings, Dams of Thin Sections	Heavy Walls, Piers, Foundations, Dams of Heavy Sections
	Water-Cement Ratio, U. S. Gal. Per Sack*		
EXTREME:			
1. In severe climates like in northern U. S., exposure to alternate wetting and drying, freezing and thawing, as at the water line in hydraulic structures .... 2. Exposure to sea and strong sulphate waters in both severe and moderate climates	5½	5½	6
SEVERE:			
3. In severe climates like in northern U. S., exposure to rain and snow, and freezing and thawing, but not continuously in contact with water .... 4. In moderate climates like southern U. S., exposure to alternate wetting and drying, as at water line in hydraulic structures	6	6	6¾
MODERATE:			
5. In climates like southern U. S., exposure to ordinary weather, but not continuously in contact with water........ 6. Concrete completely submerged, but protected from freezing	6¾	6	7½
PROTECTED.			
7. Ordinary inclosed structural members; concrete below the ground not subject to action of corrosive ground waters or freezing and thawing	7½	6	8¼

* Free water or moisture carried by the aggregate must be included as part of the mixing water

The accompanying table from a series of articles in the *Engineering News-Record*, v. 102, p. 706, May 2, 1929, gives recommended water-cement ratios for a variety of structures and degrees of exposure for a certain assumed minimum curing requirement. These curing requirements are the equivalent of 10 days' protection from loss of water at a temperature of 70 deg. F. or more. If less favorable curing conditions are to be encountered (lower temperatures or shorter time), lower water ratios must be used for the same degree of security.

This curing condition was adopted for this table as all the available tests indicate that the curing during the first two weeks is the most important factor affecting the watertightness of concrete. It is also a requirement that can be met readily on most work.

In fixing the 10-day period of moist curing at 70 deg. F., it has been assumed that there will normally be some increase beyond this period. For with this favorable start the concrete will have attained sufficient watertightness to hold within its pores some of the water necessary for further hydration. In thin sections exposed to a drying atmosphere, this continued curing may be very slight, in which case it is of the utmost importance that the protection be kept for the full period. On the other hand, large masses of concrete will lose their moisture very slowly, and more liberty can be taken in the matter of protection. In no case, however, should concrete be exposed to drying conditions before it has had at least 5 days of moist curing at 70 deg. F., if resistance comparable to that contemplated is to be expected.

If these curing requirements cannot be met, the water ratios should be reduced. This is the same as saying that richer mixes should be used. In speaking of concrete in terms of definite water-cement ratios, it should be remembered that in order to maintain constant workability, any change in water ratio must be accompanied by a change in mix.

The other requirements of good construction referred to above which must be satisfied if durable structures are to be obtained are proper aggregate combination to insure a plastic and homogeneous mixture, thorough mixing, and careful handling and placing.

Helpful Planning

We can do just this for you with your building project. During February we can devote more time to planning and can, thereby, assist you more ably, to acquire the building you want. Hence, you receive

BETTER SERVICE NOW

CLARK & SMITH, *Inc.*

GENERAL CONTRACTORS

13 Temple Street. Granite 3632. QUINCY

Our Reputation

BUILT ON

Price—Quality—Time

If you consult us regarding your new building, we will quote you a Fair PRICE, give you the Best QUALITY and build in the Shortest TIME.

CLARK and SMITH, Inc.

BUILDING CONTRACTORS

13 TEMPLE STREET Granite 3632 QUINCY

Selling Construction Service

Showing How Effective Advertising and Aggressive Personal Selling Can Produce Business for Concrete Contractors

"IN 1926, $50,000 worth of work was directly traceable to $500 worth of advertising."

This statement, made recently by Oberlin S. Clark of the contracting firm of Clark & Smith, Inc., Quincy, Massachusetts, gives the reason why he and his business associates are all firm believers in advertising that sells.

Ever since this contracting firm was organized in 1925, advertising has been the keynote of the success and prosperity enjoyed by Clark & Smith, Inc. The various forms of advertising used and the quality of work produced have made the name, *Clark & Smith, Inc.*, synonymous with good construction in Quincy and vicinity.

Forms of Advertising Used

At the present time, direct-mail pieces are sent out each month to a live mailing list of 2,000 prospects who at some time or other will have need for the services of Clark & Smith, Inc. In addition to this direct-mail advertising, which includes letters, circulars and sometimes single sheets carrying a sales message, display advertising is placed regularly in the daily newspapers. So extensive is the newspaper advertising program, that every time the firm does an outstanding job there is a story about it in the leading newspapers. This latter form of advertising is free and is a result of the good will Clark & Smith, Inc., have developed in their locality. Just as this helps to keep the name, *Clark & Smith, Inc.*, continually before the public, job signs and truck signs are used for the same purpose.

Advertising alone, however, is not expected to do all the selling for Clark & Smith, Inc. These contractors follow up their advertising by personal calls on prospects. Nevertheless, the value of the various forms of advertising used is realized for the advertising paves the way for the necessary personal selling; it makes selling easier.

"Cold Weather" Advertising

At this time of the year, it is interesting to note the "cold weather" advertising of Clark & Smith, Inc. While the trend to cease operating during the winter months is becoming less and less apparent every year, some contractors still discontinue work during cold weather. This is not true in the case of Clark & Smith, Inc., however; they work the year 'round. In the closing days of December, 1927, the Boston Gear Works gave Clark & Smith, Inc., a contract to erect a building for which the plans were not completed. The company wanted the building ready for occupancy by April 1, 1928. Clark & Smith, Inc., finished the job in record time and used the job as an *advertisement* of the services they could perform. A copy of the letter used to inform prospects of this achievement is presented here to show how the job was advertised to help get other jobs.

Another method used to "put pep" in building operations during what is known as the "off season" is the distributing of an inexpensive direct-mail piece such as a post card. One of Clark & Smith's cards, used for this purpose, is illustrated here.

As has already been indicated, several forms of advertising are utilized regularly by Clark & Smith, Inc.; in fact they never miss an opportunity to present prospects with interesting facts about the business and the services the firm can give at all times and under any condition or circumstances.

Interesting Sales Letters

The letters used in the direct-mail campaign are clev-

Do Business Better

AND

Make Better Business

If your job requires First Class Equipment, WE HAVE IT
If it requires Quality Service, WE GIVE IT

CLARK & SMITH, Inc.

GENERAL CONTRACTORS

13 TEMPLE ST. Granite 3632 QUINCY

BUILDINGS OF DISTINCTION

If yours is a distinctive business, promote that business with a building of distinction. We can build the building, and you can build the business.

CLARK & SMITH, Inc.

13 Temple Street. Granite 3632 Quincy, Mass.

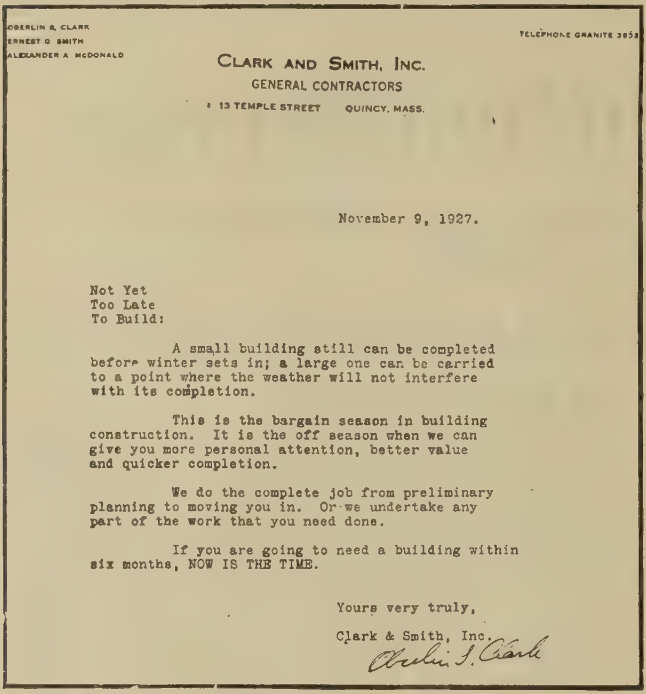
erly written, interesting and quite unusual. For example, one letter has the heading, "Equipment Makes the Building Grow," and stresses the fact that customers of Clark & Smith, Inc., "get the benefit of willing workmen, the best construction equipment and efficient management." Some of the letters used by this firm of contractors in their direct-mail campaigns are reproduced here as suggestions for other contractors.

"Good Equipment Cuts Construction Costs," is the heading for another letter. This sales message is cleverly written and assures customers that Clark & Smith, Inc., use the best modern equipment.

Asking the question, "Does Scheduled Construction Appeal to You?" another letter is devoted to the speed and ease with which Clark & Smith, Inc., can complete a job.

Newspaper Publicity

Reference has been made to the newspaper publicity that Clark & Smith, Inc., have been able to get from time to time. A particular job, a sea wall, involved consider-



OBERLIN S. CLARK
ERNEST G. SMITH
ALEXANDER A. McDONALD

TELEPHONE GRANITE 3832

CLARK AND SMITH, INC.
GENERAL CONTRACTORS
13 TEMPLE STREET QUINCY, MASS.

November 9, 1927.

Not Yet
Too Late
To Build:

A small building still can be completed before winter sets in; a large one can be carried to a point where the weather will not interfere with its completion.

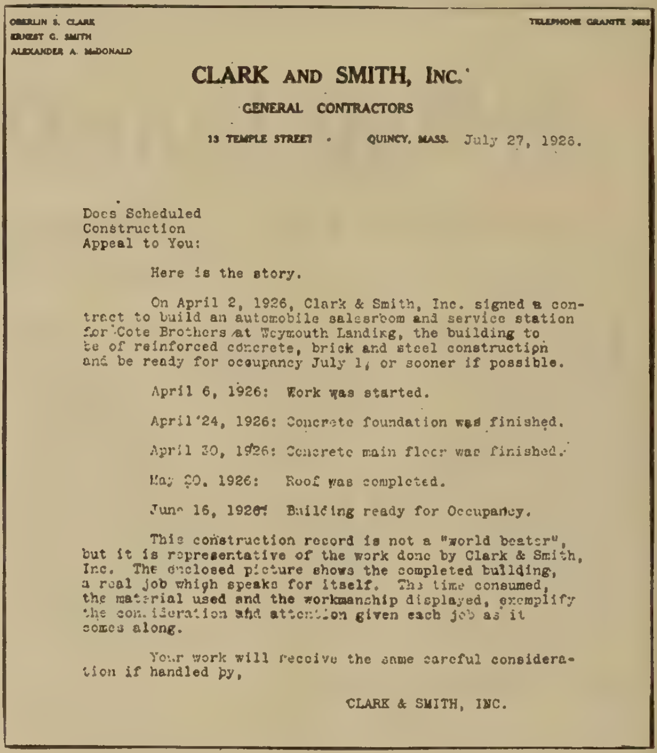
This is the bargain season in building construction. It is the off season when we can give you more personal attention, better value and quicker completion.

We do the complete job from preliminary planning to moving you in. Or we undertake any part of the work that you need done.

If you are going to need a building within six months, NOW IS THE TIME.

Yours very truly,

Clark & Smith, Inc.
Oberlin S. Clark



OBERLIN S. CLARK
ERNEST G. SMITH
ALEXANDER A. McDONALD

TELEPHONE GRANITE 3832

CLARK AND SMITH, INC.
GENERAL CONTRACTORS
13 TEMPLE STREET QUINCY, MASS.

July 27, 1926.

Does Scheduled
Construction
Appeal to You:

Here is the story.

On April 2, 1926, Clark & Smith, Inc. signed a contract to build an automobile salesroom and service station for Cote Brothers at Weymouth Landing, the building to be of reinforced concrete, brick and steel construction and be ready for occupancy July 1, or sooner if possible.

April 6, 1926: Work was started.

April 24, 1926: Concrete foundation was finished.

April 30, 1926: Concrete main floor was finished.

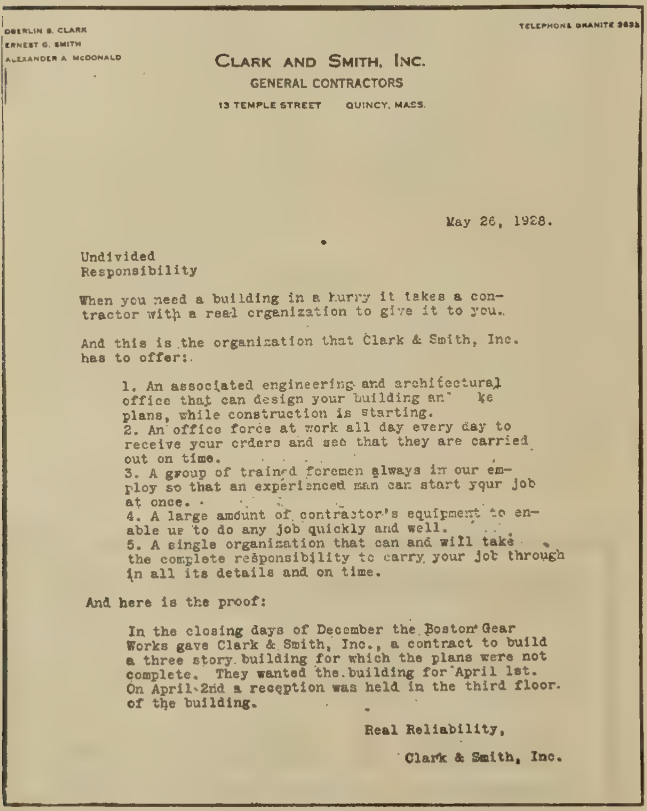
May 20, 1926: Roof was completed.

June 16, 1926: Building ready for Occupancy.

This construction record is not a "world beater", but it is representative of the work done by Clark & Smith, Inc. The enclosed picture shows the completed building, a real job which speaks for itself. The time consumed, the material used and the workmanship displayed, exemplify the consideration and attention given each job as it comes along.

Your work will receive the same careful consideration if handled by,

CLARK & SMITH, INC.



OBERLIN S. CLARK
ERNEST G. SMITH
ALEXANDER A. McDONALD

TELEPHONE GRANITE 3832

CLARK AND SMITH, INC.
GENERAL CONTRACTORS
13 TEMPLE STREET QUINCY, MASS.

May 26, 1928.

Undivided
Responsibility

When you need a building in a hurry it takes a contractor with a real organization to give it to you.

And this is the organization that Clark & Smith, Inc. has to offer:

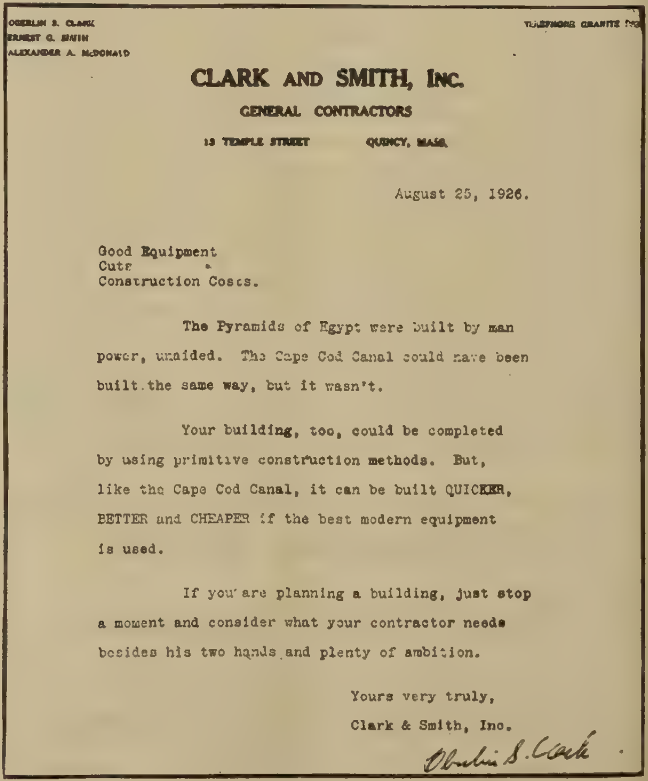
1. An associated engineering and architectural office that can design your building an ke plans, while construction is starting.
2. An office force at work all day every day to receive your orders and see that they are carried out on time.
3. A group of trained foremen always in our employ so that an experienced man can start your job at once.
4. A large amount of contractor's equipment to enable us to do any job quickly and well.
5. A single organization that can and will take the complete responsibility to carry your job through in all its details and on time.

And here is the proof:

In the closing days of December the Boston Gear Works gave Clark & Smith, Inc., a contract to build a three story building for which the plans were not complete. They wanted the building for April 1st. On April 2nd a reception was held in the third floor of the building.

Real Reliability,

Clark & Smith, Inc.



OBERLIN S. CLARK
ERNEST G. SMITH
ALEXANDER A. McDONALD

TELEPHONE GRANITE

CLARK AND SMITH, INC.
GENERAL CONTRACTORS
13 TEMPLE STREET QUINCY, MASS.

August 25, 1926.

Good Equipment
Cuts
Construction Costs.

The Pyramids of Egypt were built by man power, unaided. The Cape Cod Canal could have been built the same way, but it wasn't.

Your building, too, could be completed by using primitive construction methods. But, like the Cape Cod Canal, it can be built QUICKER, BETTER and CHEAPER if the best modern equipment is used.

If you are planning a building, just stop a moment and consider what your contractor needs besides his two hands and plenty of ambition.

Yours very truly,

Clark & Smith, Inc.
Oberlin S. Clark

Four effective sales letters that tell of the work Clark and Smith, Inc., do, their resources, and their services.

able concrete construction work.

Newspaper advertisements of Clark & Smith, Inc., always carry an important sales message, as is shown by the representative "ads" that accompany this article. One interesting advertisement includes a list of *satisfied clients.* Another tells about the power equipment used by Clark & Smith, Inc., including concrete mixers, concrete placing plant, motor trucks and tractors and the other standard

Build so it wont Burn

Make Every Week

Fire Prevention Week

A good way to PREVENT A FIRE is to plan your building of materials that won't burn. We can do it and give you the best there is.

Clark & Smith, Inc.

GENERAL CONTRACTORS
13 Temple St. Granite 3632. QUINCY

By publishing this advertisement, Clark & Smith, Inc., cooperated in the national movement to reduce fire losses

TO TAKE CARE OF OUR INCREASED BUSINESS
WE HAVE INSTALLED

TWO NEW TELEPHONES

GRA. 8930 GRA. 8931

CLARK & SMITH, INC.

13 TEMPLE ST. QUINCY, MASS.

PRESENT NUMBER GRA. 3632 DISCONTINUED

BETTER BUILDING SERVICE NOW.

More time and effort spent on your building problem now, will develop your project to a successful start in the spring.
By starting early and planning carefully, you are assured of a better building.
We have more time to help in January and February than at any other season. That is why we can give you

BETTER SERVICE NOW.

CLARK & SMITH, INC.

13 TEMPLE ST. GRANITE 3632 QUINCY, MASS.

Two cards distributed by Clark & Smith, Inc.

DURING 1928
CLARK & SMITH, INC.
DID WORK FOR:

David Evans
Harold Ruxton
Charles Beasley
William Andrew
H. N. Worthington
Edmund S. Hunt & Sons
J. Prouty
John Santagata
Mathewson Machine Co.
Quincy Trust Co.
Woodward Spring Shop
Karl Karjalainen
J. Palmer
C. Mc Combe
Bryan Leonard
William Dennison
Stein & Applebaum
Warren Crane
John J. Gallagher, Inc.
Boston Consolidated Gas Co.
Dr. N. E. Austin
Boston Gear Works
Cities Service Refining Co.
F. D. Lawley, Inc.
Laing Brothers Co.
Meyer Winer
Swift & Company
Irving Johnson
Thompson Wire Co.
Alfred Hale Rubber Co.
T. A Ridder Co., Inc.
Carl Sheppard
J. M. Mc Leod
South Shore Filling Station
W. B. Nichols
Godfrey Coal Co.
Nelson Brothers
P. J. Donaghey & Son
Warshaw's Inc.
William H. Muldoon
Weymouth Wool Scouring Co.
H. & R. Rubber Co.
Walter Stover
Old Colony Gas Co.

CLARK & SMITH, INC.
CONTRACTORS & BUILDERS

13 TEMPLE ST. GRANITE 3632 QUINCY.

In the original of this mailing piece, red ink was used to make the title and the name of the firm stand out

POWER EQUIPMENT

FOR GENERAL CONSTRUCTION

SAVES TIME—REDUCES COST

CLARK & SMITH, Inc., use the following equipment for construction purposes.

7 ft. Concrete Mixer
5 ft. Concrete Mixer
3 ft. Concrete Mixer
Concrete Placing Plant
Power Hoist
Saw Table
Trench Pump
M-M Power Shovel ½ yard
Large and Small Sanding Machines
Fordson Tractor and Trailer Equipment
Low Gear Trailer — 10 Ton capacity.
G. M. C. Truck — 2 Ton Capacity — Dump Body

This equipment is available for hire at reasonable prices.

CLARK & SMITH, Inc.

13 Temple Street. Granite 3632. Quincy.

This advertisement shows that Clark & Smith, Inc., are prepared to handle any job of concrete construction equipment employed by the modern contractor. Other smaller advertisements are used to keep the name Clark & Smith, Inc., before the public at all times.

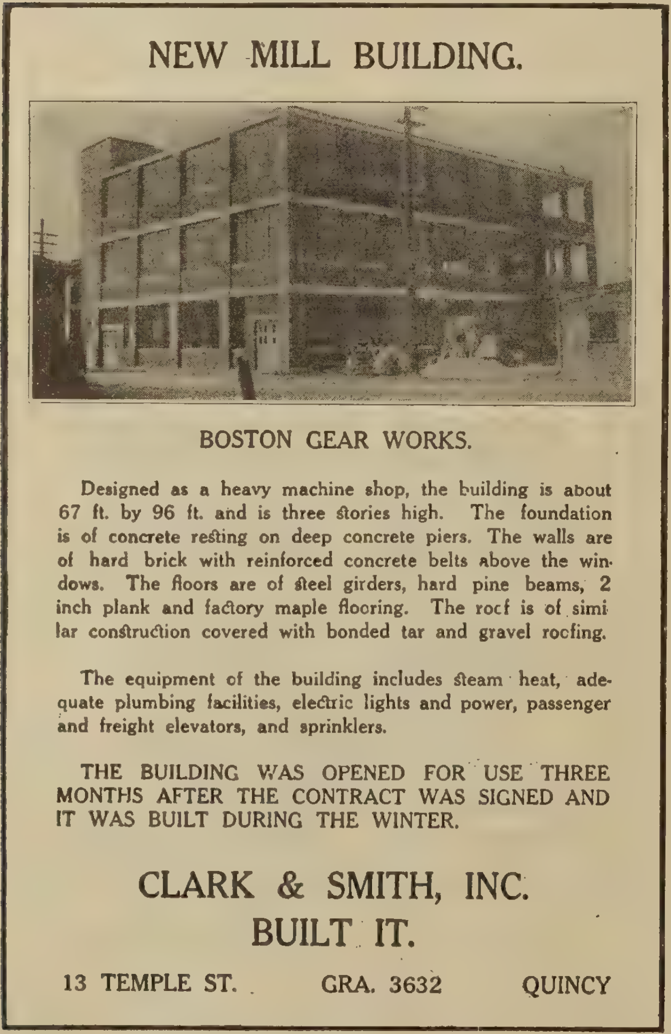
Post Card Mailing Pieces

Inexpensive post cards bring good results when mailed to live prospects, according to Clark & Smith, Inc. Two of the cards are used in this article as illustrations. One of the cards was sent to customers and prospects on the regular mailing list when the firm found that an extra telephone would facilitate handling the daily business routine.

Printed Salesmanship

Clark & Smith, Inc., have made a practice of keeping old, new and prospective customers informed of the work done by the firm. Each year a list of outstanding jobs is sent to all names on the up-to-date mailing list. For example, the list mailed early in 1926 was in the form of a simple four-page circular having a printed sales message on page one, an interesting letter from the firm on pages two and three and on page four a list of leading customers for whom construction jobs were done in 1925. The mailing piece this year, listing leading customers for 1928, was quite simple yet was very effective.

Realizing that new construction work being done for a certain industry is of interest to competitors in the same industry, Clark & Smith, Inc., have an effective method of advertising such jobs. For example, if the firm is building a new service station for an oil company, other oil companies in the same territory receive direct-mail pieces describing the progress of the work. This advertising paves the way for selling new service stations to the competitors.



NEW MILL BUILDING.

BOSTON GEAR WORKS.

Designed as a heavy machine shop, the building is about 67 ft. by 96 ft. and is three stories high. The foundation is of concrete resting on deep concrete piers. The walls are of hard brick with reinforced concrete belts above the windows. The floors are of steel girders, hard pine beams, 2 inch plank and factory maple flooring. The roof is of similar construction covered with bonded tar and gravel roofing.

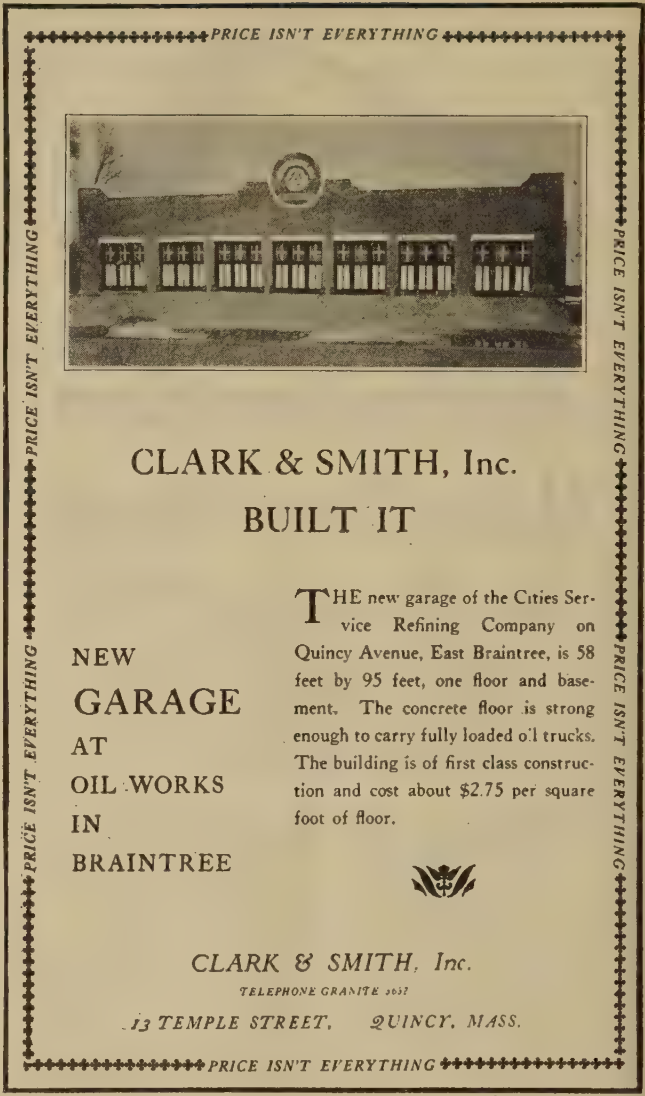
The equipment of the building includes steam heat, adequate plumbing facilities, electric lights and power, passenger and freight elevators, and sprinklers.

THE BUILDING WAS OPENED FOR USE THREE MONTHS AFTER THE CONTRACT WAS SIGNED AND IT WAS BUILT DURING THE WINTER.

CLARK & SMITH, INC.
BUILT IT.

13 TEMPLE ST. GRA. 3632 QUINCY

There was considerable concrete work in this job built by Clark & Smith, Inc.



PRICE ISN'T EVERYTHING

CLARK & SMITH, Inc.
BUILT IT

NEW
GARAGE
AT
OIL WORKS
IN
BRAINTREE

THE new garage of the Cities Service Refining Company on Quincy Avenue, East Braintree, is 58 feet by 95 feet, one floor and basement. The concrete floor is strong enough to carry fully loaded oil trucks. The building is of first class construction and cost about $2.75 per square foot of floor.

CLARK & SMITH, Inc.
TELEPHONE GRANITE 3632
13 TEMPLE STREET, QUINCY, MASS.

PRICE ISN'T EVERYTHING

An attractive folder—one of the first pieces used by Clark & Smith, Inc.

Advertising That Sells

Carefully planned advertising campaigns, including timely newspaper advertisements, distribution of direct-mail pieces to a live mailing list, notices in telephone directories and signs on jobs and trucks, together with aggressive personal selling have brought Clark & Smith, Inc., a big volume of business.

Milwaukee Remodeling Permits Show Effect of Modernizing Campaign

The first report on the progress of the Home Modernizing Bureau of Milwaukee, Wisconsin, shows an astounding increase if a comparison of modernizing permits is any indication. Permits for this work have approximately doubled during the first five months of the campaign, according to the City Building Inspector's Office. The increase of $1,500,000 does not include electrical and plumbing work, redecorating or refurnishing.

Modern Stucco and Plaster

A Discussion of Standard Practice in Application of Portland Cement Stucco and Plaster

Bases for Portland Cement Stucco

(Installment II)

SUCCESS in the application of portland cement stucco requires that it be used either (1) as a material that is bonded to and becomes an integral part of the base to which it is applied, such as stucco on masonry, or (2) as a thin reinforced concrete slab anchored to the structure but not itself forming an integral part of the backing. An example of the latter is stucco applied on metal reinforcement over frame structures.

Masonry Walls as Base for Stucco

Walls of concrete masonry, hard-burned clay tile and hard or medium clay brick are excellent bases for the direct application of portland cement stucco. The surfaces of these units should be rough to provide good mechanical key and should be free from paint, oil, dust, dirt, soot, or any other material that might interfere with satisfactory bond. Joints may be struck off flush or slightly raked.

Old masonry walls when softened by weathering, surfaces that cannot be cleaned thoroughly, such as painted brickwork, and all chimneys, will require a covering of metal reinforcement before applying stucco. See following section on "Metal Reinforcement."

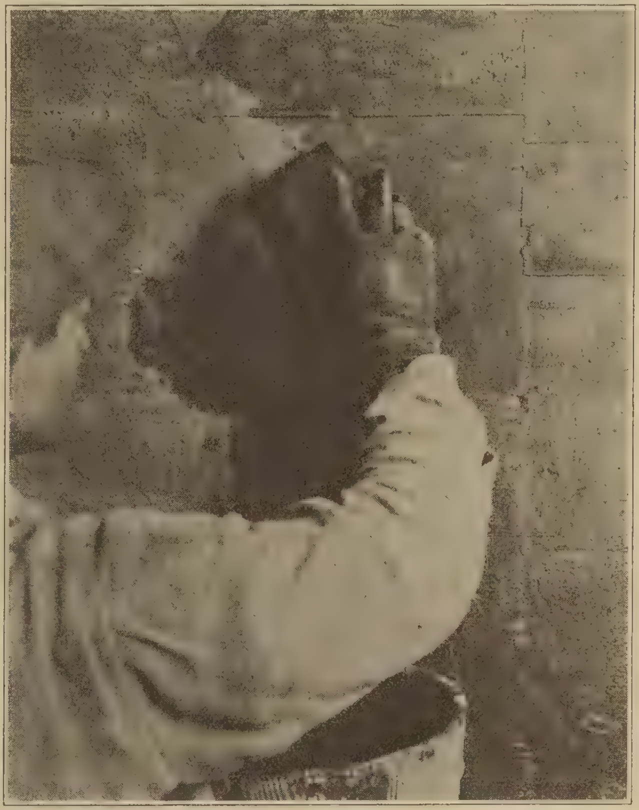
Monolithic Concrete

Monolithic concrete walls that have coarse or roughened surfaces are suitable bases for direct application of portland cement stucco. When the surfaces are not rough enough to provide anchorage, it is necessary to prepare them as follows:

(1) Old monolithic concrete walls should be roughened with bush-hammers or other special tools and then washed thoroughly with water to remove all dirt and loose particles.

One method of preparing monolithic concrete to receive stucco. A special compound painted on the forms retards hardening in the surface concrete, permitting the aggregate to be exposed by brushing

(2) Acid-washing, using a solution of 1 part muriatic acid to 6 parts water is another method of preparing old concrete surfaces to receive stucco. First the wall should be wetted with water so that the acid will act on the surface only. More than one application of acid may be necessary. After this treatment the wall must be washed thoroughly with water to remove all traces of the acid. If the wall is not roughened sufficiently by the acid it will be necessary to use bush-hammers as mentioned in the preceding paragraph.



Acid-washing monolithic concrete will improve the bond between the dash coat and the concrete surface. The acid is being applied with a scrubbing brush

(3) New monolithic concrete can be roughened with a heavy wire brush or a special scoring tool if forms are removed early. In such cases care must be taken not to remove forms before the concrete is hard enough to be self-sustaining. Forms for concrete that is to receive stucco should not be given oil or soap coatings, as these are likely to remain on the concrete, interfering with bond. Oil on the surface of concrete can be removed by washing with soap and water.

(4) Another method of providing rough surfaces on monolithic concrete is by the use of a special large-mesh

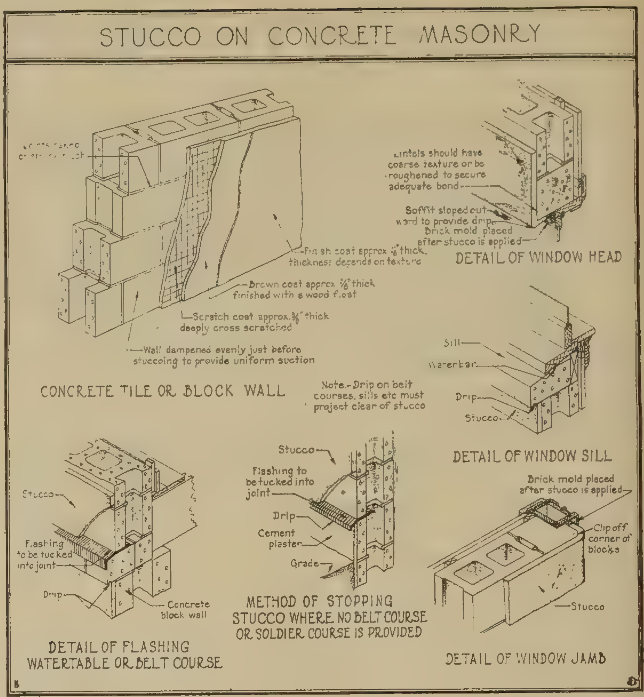
patented burlap placed on form faces. After forms are removed the burlap is stripped off the concrete, leaving a deeply scored surface.

(5) Monolithic surfaces also can be roughened through the use of special compounds painted on the form faces. These retard hardening of the surface concrete. The desired roughness is secured by brushing off the surface material after forms are removed.

Metal Reinforcement

Metal reinforcement must be used for stucco applied on wood or steel frame structures of the open or sheathed type, on masonry structures that do not provide satisfactory bond, for example, chimneys and disintegrating surfaces, and on old stucco surfaces which are to be refinished. Refinishing old stucco jobs will be discussed in Installment 3. Metal reinforcement also must be employed wherever stucco is to be carried over flashing.

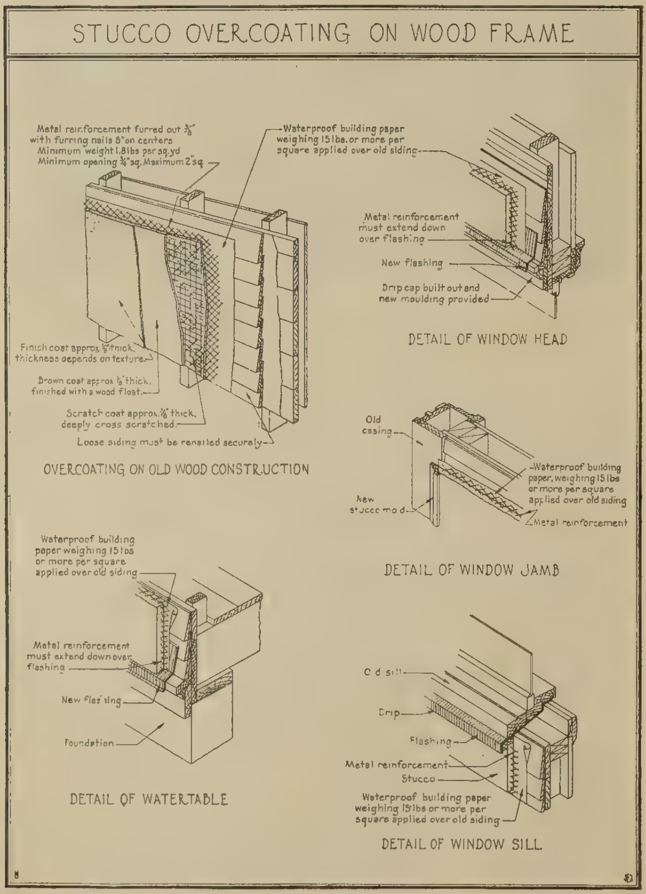
Scratch coat is applied directly to masonry walls having a coarse texture



STUCCO ON CONCRETE MASONRY

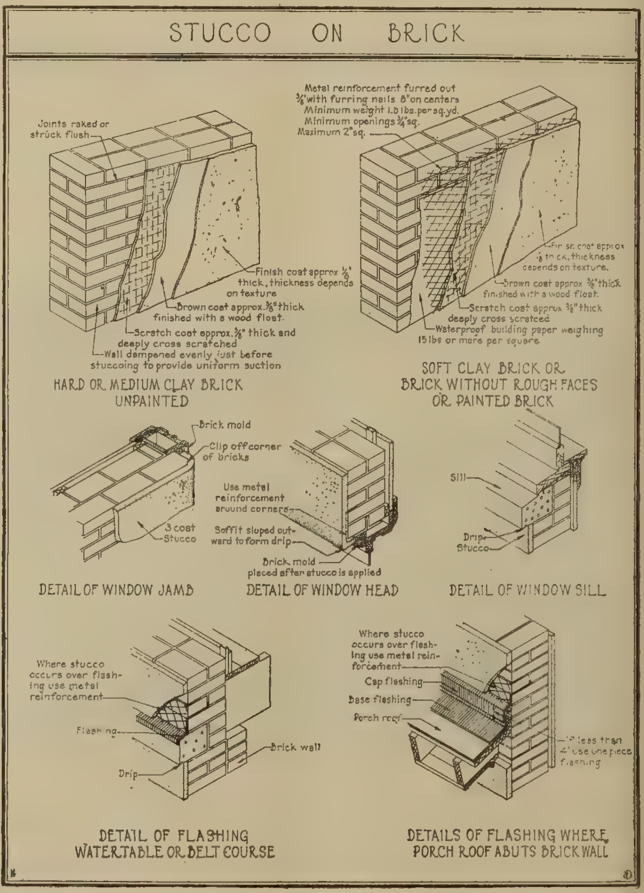
Joints raked or struck flush
Lintels should have coarse texture or be roughened to secure adequate bond
Soffit sloped outward to provide drip
Brick mold placed after stucco is applied
DETAIL OF WINDOW HEAD
Finish coat approx ⅛" thick, thickness depends on texture
Brown coat approx ⅜" thick finished with a wood float
Scratch coat approx. ⅜" thick deeply cross scratched
Wall dampened evenly just before stuccoing to provide uniform suction
CONCRETE TILE OR BLOCK WALL
Note.-Drip on belt courses, sills etc must project clear of stucco
Sill
Waterbar
Drip
Stucco
DETAIL OF WINDOW SILL
Stucco
Flashing to be tucked into joint
Drip
Concrete block wall
DETAIL OF FLASHING WATERTABLE OR BELT COURSE
Stucco
Flashing to be tucked into joint
Drip
Cement plaster
Grade
METHOD OF STOPPING STUCCO WHERE NO BELT COURSE OR SOLDIER COURSE IS PROVIDED
Brick mold placed after stucco is applied
Clip off corner of blocks
Stucco
DETAIL OF WINDOW JAMB

Structures to receive stucco on metal reinforcement should be well braced and rigid. Studs in sheathed construction should be not more than 16 in. on centers, tied together below floor joists and bridged at least once every story height. Diagonal bracing at all corners, let into studs, is recommended to give additional rigidity. Sheathing should be placed horizontally and well nailed on each stud. In open wood-frame construction, studs



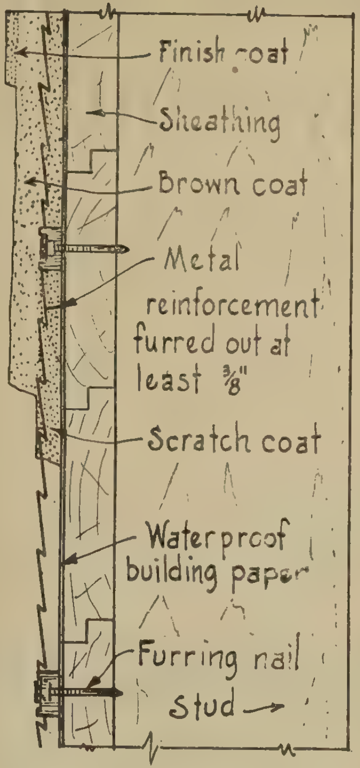
STUCCO OVERCOATING ON WOOD FRAME

Metal reinforcement furred out ⅜" with furring nails 8" on centers Minimum weight 1.8 lbs per sq. yd Minimum opening ¾" sq. Maximum 2" sq.
Waterproof building paper weighing 15 lbs. or more per square applied over old siding
Finish coat approx. ⅛" thick, thickness depends on texture
Brown coat approx ⅜" thick, finished with a wood float.
Scratch coat approx. ⅜" thick, deeply cross scratched.
Loose siding must be renailed securely
OVERCOATING ON OLD WOOD CONSTRUCTION
Metal reinforcement must extend down over flashing
New flashing
Drip cap built out and new moulding provided
DETAIL OF WINDOW HEAD
Old casing
New stucco mold
Waterproof building paper, weighing 15 lbs or more per square applied over old siding
Metal reinforcement
DETAIL OF WINDOW JAMB
Waterproof building paper weighing 15 lbs or more per square applied over old siding
Metal reinforcement must extend down over flashing
New flashing
Foundation
DETAIL OF WATERTABLE
Old sill
Drip
Flashing
Metal reinforcement
Stucco
Waterproof building paper weighing 15 lbs or more per square applied over old siding
DETAIL OF WINDOW SILL

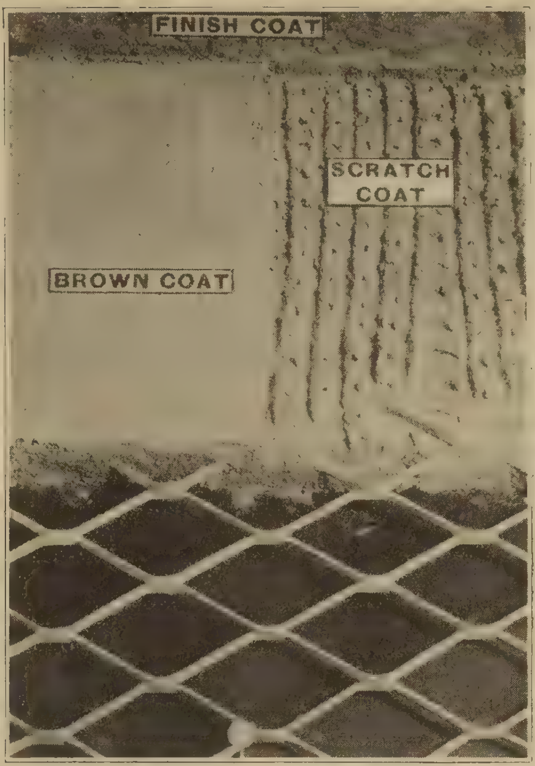


STUCCO ON BRICK

Joints raked or struck flush
Finish coat approx ⅛" thick, thickness depends on texture
Brown coat approx. ⅜" thick finished with a wood float.
Scratch coat approx. ⅜" thick and deeply cross scratched
Wall dampened evenly just before stuccoing to provide uniform suction
HARD OR MEDIUM CLAY BRICK UNPAINTED
Metal reinforcement furred out ⅜" with furring nails 8" on centers Minimum weight 1.8 lbs. per sq. yd. Minimum openings ¾" sq. Maximum 2" sq.
Finish coat approx ⅛" thick, thickness depends on texture.
Brown coat approx ⅜" thick finished with a wood float.
Scratch coat approx ⅜" thick deeply cross scratced
Waterproof building paper weighing 15 lbs or more per square
SOFT CLAY BRICK OR BRICK WITHOUT ROUGH FACES OR PAINTED BRICK
Brick mold
Clip off corner of bricks
3 coat Stucco
DETAIL OF WINDOW JAMB
Use metal reinforcement around corners
Soffit sloped outward to form drip
Brick mold placed after stucco is applied
DETAIL OF WINDOW HEAD
Sill
Drip
Stucco
DETAIL OF WINDOW SILL
Where stucco occurs over flashing use metal reinforcement
Flashing
Drip
Brick wall
DETAIL OF FLASHING WATERTABLE OR BELT COURSE
Where stucco occurs over flashing use metal reinforcement
Cap flashing
Base flashing
Porch roof
If less than 4' use one piece flashing
DETAILS OF FLASHING WHERE PORCH ROOF ABUTS BRICK WALL


Finish coat
Sheathing
Brown coat
Metal reinforcement furred out at least ⅜"
Scratch coat
Waterproof building paper
Furring nail
Stud

Showing proper construction for stucco on metal reinforcement. Note the backing of waterproof building paper, the metal reinforcement held at least ⅜ in. away from the backing with furring nails, and the scratch coat filled in solidly behind the metal



should be not over 12 in. on centers and braced rigidly as described for sheathed construction.

Surfaces that are to receive metal reinforcement (excepting areas to be back-plastered) should first be covered with waterproof building paper. On open construction the paper serves as a backing for the scratch coat. In the case of sheathed construction and on those masonry surfaces requiring metal reinforcement it prevents absorption of moisture from the fresh mortar.

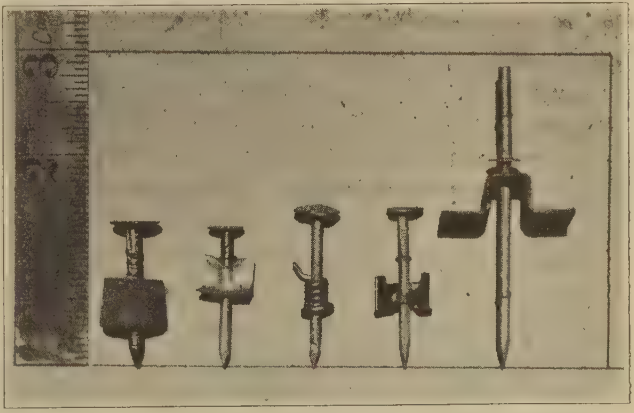
The paper is attached with large-headed galvanized nails. Upper strips should overlap lower strips at least 3 in. Vertical joints should be lapped at least 6 in. To support the paper and prevent tearing on open frame construction, wires (usually No. 18 gauge) should be stretched tightly across the faces of the studs in single strands at 6- or 8-in. intervals.

Metal reinforcement should be a large-mesh type of expanded metal or wire fabric. Its minimum net weight should be 1.8 lbs. per sq. yd. or 20 lbs. per 100 sq. ft. For some jobs, a heavier product is desirable. The openings should be not smaller than ¾ in. square nor larger than 2 in. square. For back-plastered construction, metal lath or wire lath weighing 3.4 lbs. per sq. yd. is recommended.

Large openings in the reinforcement are desirable so that the mortar will be pushed through to the backing, completely embedding the metal. Where there is no backing, as in work to be back-plastered, reinforcement of relatively small mesh (metal lath or wire lath) is necessary. Complete coverage of the metal in the latter case is secured when the back-plaster coat is applied.

The reinforcement must be securely attached. It should be furred at least ⅜ in. from the face of the wall or studs so that stucco can be forced behind the metal. Furring nails or other furring devices that will not reduce the effective thickness of the stucco should be used. See illustration. Furring strips are objectionable as they make planes of weakness in the stucco slab and cracking may result.

Reinforcement should form a continuous network of metal over the entire surface. All laps should be at least one mesh wide and securely wired. Butt-joints should not be used unless special care is taken to lace the sheets together securely. Sheets of reinforcement should be returned around corners at least one stud spacing on open frame construction and at least 4 in. on other types of construction.



There are several types of furring nails to accommodate practically any of the types of stucco reinforcement available

Overcoating

There is a growing demand for portland cement stucco for the overcoating of old houses. Any loose siding on old frame buildings to be "overcoated" should be securely renailed. All woodwork and trim should be built out to provide sufficient projection and proper drips. Waterproof paper and metal reinforcement must be applied as described in the preceding paragraphs on "Metal Reinforcement."

Buffalo Contractor Sells Work on Time Payment Plan

A. C. Wetsen Initiates Terms for Concrete Work in Buffalo—Uses Salesmen, Mail and Newspaper Advertising to Advertise Feature

"THE name 'Wetzen,' stamped on concrete, is a mark of quality."

This is one of the slogans used by A. C. Wetzen of Buffalo, New York, who has been in the concrete contracting business for five years. Today he is regarded as one of the most successful contractors in Buffalo, having specialized in nothing but concrete construction.

His success can be attributed largely to the fact that he has found many ways to let people know of the Time Payment Plan of which he is the originator in Buffalo. Accompanying reproductions of advertisements he publishes in the Buffalo daily newspapers show one of the ways he "puts his story across." These advertisements explain the Time Payment Plan.

Began With Six Salesmen

About two years ago Mr. Wetzen conceived the idea of the Time Payment Plan and employed six salesmen to go from door to door explaining the features of the plan and taking orders for concrete work. Although this method worked very well, he decided that advertising would reach a greater number of prospects. It did and he was able to increase his volume of business considerably through advertising which paved the way for the salesmen. He was thus able to reduce his sales force to four men and do a larger business at the same time.

Being thoroughly sold on advertising, he placed a large sign, "See Wetzen for Easy Terms for Your Concrete Work," on each of his trucks. And a large amount of new business can be traced directly to these simple but effective signs.

Workmen's Uniforms Carry Advertising

Later he devised another effective method of keeping the name "Wetzen" before the public. Each of his workmen was required to wear dark blue coveralls with "Wetzen" across the back in brilliant yellow letters. The word "Terms" was also emblazoned across the front in the same outstanding yellow letters. Mr. Wetzen reports that a crew at work attracted so much attention that, by having his salesmen concentrate on that particular neighborhood, three or four new jobs were often signed up before the first job was finished. Signs on every job also tell that Wetzen is doing the work.

IF IT'S A WETZEN

CONCRETE DRIVEWAY

YOU CAN BE SURE OF A PERMANENT, DURABLE, ECONOMICAL AND ATTRACTIVE DRIVE

The Popular WETZEN Plan

20% of contract price is your initial payment, balance over a period of 6 to 12 months.

Originator of the time payment plan at lowest possible rates for this type of work!

QUALITY MATERIALS, SKILLED WORKMANSHIP, STRICT SUPERVISION.

Ask for Estimate

A. C. WETZEN

83 Roesch Ave. **Riverside 5226**

There's No Use Talking

THE WETZEN

CONCRETE DRIVEWAY

Is, without a doubt, the best that money can buy. Materials — workmanship — price, all predominate in every Wetzen drive. Every assurance of a perfect job and one you will be proud to have on your property. A. C. Wetzen comes well recommended because of the satisfactory jobs done for property owners in every section of Buffalo.

Then, Too, There is The Popular WETZEN Plan

20% of contract price is your initial payment, balance over a period of 6 to 12 months.

The name "Wetzen," stamped on concrete, is a mark of quality.

QUALITY MATERIALS, SKILLED WORKMANSHIP, STRICT SUPERVISION

Ask for Estimate

A. C. WETZEN

83 Roesch Ave. **Riverside 5226**

Another means of advertising which contributed to the success A. C. Wetzen now enjoys was a direct-mail campaign to 10,000 prospects with the mailing piece being a circular entitled, "$90,000 Worth of Driveways Without a Complaint."

Other Concrete Work

The concrete driveway market is not the only one Mr. Wetzen has been working in, for his contracting company also builds concrete sidewalks, ash containers, porch floors, tennis courts, alleys, foundations, basement floors and residence floors in addition to doing remodelling work wherever the use of concrete is justified.

Mr. Wetzen's merchandising activities this year include newspaper and direct-mail advertising and aggressive personal selling through the four salesmen regularly employed.

Detroit and Canada Tunnel

(Continued from page 16)

weight only. Strength is of little value and, as a result rigid control is not necessary. A very plastic concrete is needed and more water is used than would be used if strength were an objective.

Aggregate for the tremie concrete consists of combined sand and gravel running about 40 per cent sand and 60 per cent gravel. It is brought to the plant in scows and transferred to the bins by clamshell and derrick.

After leaving the mixer the concrete is diverted to one or another of the hoisting towers, hoisted to a distributing tower and dropped into place through 10-in. rubber hose. The balance of the outside concrete, except a small portion at the top of the tube, is placed at this location.

When enough tremie concrete has been placed to weight the tube down to the point where it is almost ready to sink, it is fastened to two scows, one at each end of the tube. The tubes are fastened in such a manner that they can be raised or lowered by means of hoists on the buoyancy scows.

The tube is then towed from the tremie plant to its location in the trench. Before it is sunk it is aligned by means of masts as shown in Figure 9. The tube is sunk by weighting it down with nine 5-ton concrete blocks.

After the tube is in place, the tremie concrete plant is brought to the site and the remaining tremie concrete is placed.

Preparing the Trench

The tubes are placed in a 45 ft. trench excavated along

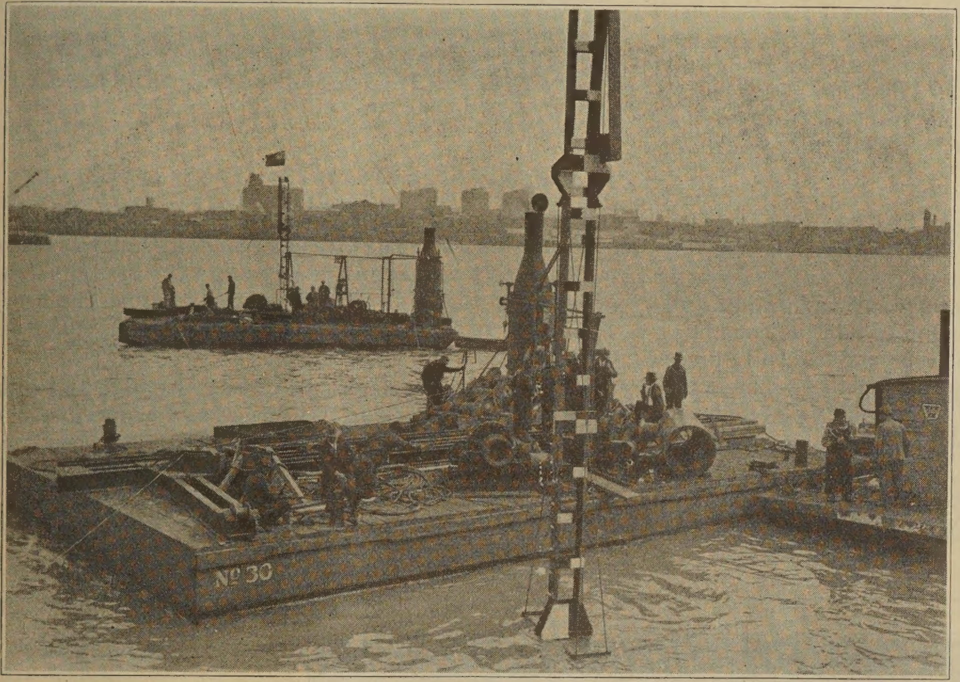


Figure 9. The tubes were lowered in place by means of winches mounted on barges at each end. They were lined up by means of the masts as shown

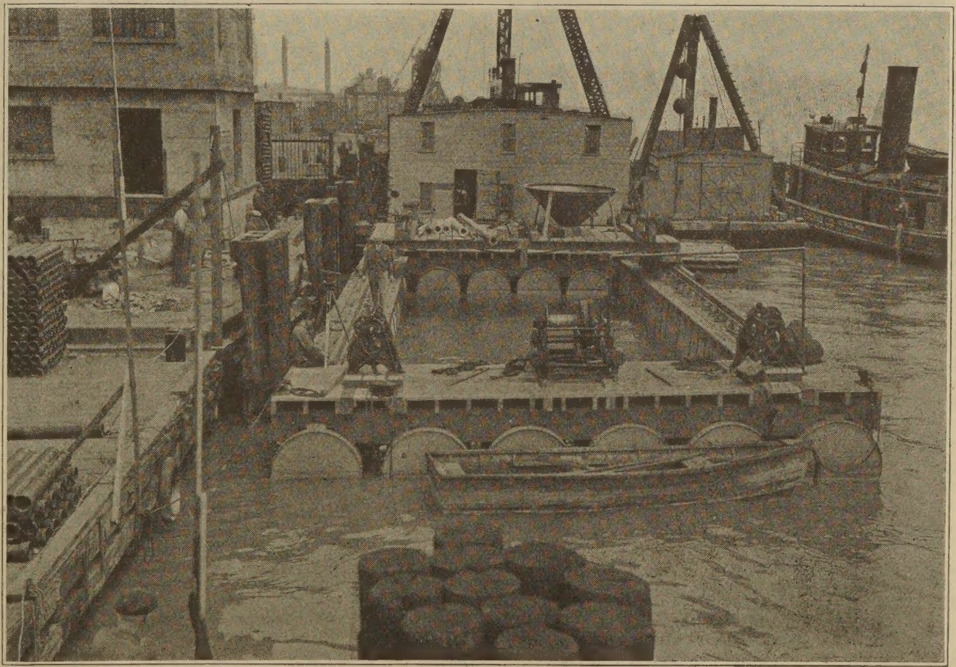


Figure 10. The "None-Such" sand drag by means of which the sand cushion in the excavated trench was struck off to the proper grade

the tunnel alignment and extending from shore to shore. Approximately 300,000 cu. yds. of river bottom material were excavated in this section. Enough of the excavated material to provide the necessary back-fill after the tubes are placed is stored so that it can be reclaimed. A bed of sand and gravel from two to four feet thick is placed in the bottom of the trench to provide a satisfactory bed upon which the tubes will rest.

Just before a tube is placed the sand bed in the trench is "swept" with a unique device developed on this project. It is illustrated in Figure 10. The "None Such" consists of a rectangular framework floated by means of steel tanks as shown. Extending lengthwise on the steel frame are rails upon which a carriage carrying a grillage or "screed" which extends down into the water, is operated.

The "None Such" is towed to the location over the trench at which the tube is to be sunk in such a position that the rails are parallel to the center line of the tunnel. Sixteen thousand lb. weights attached to windlasses at each corner of the raft act as anchors and enable the contractor to set the rails of the "None Such" at grades that will cause the screed to "strike off" the sand bed to exactly the desired elevation. When the frame is properly anchored to line and grade, a winch pulls the screed forward over the rails.

Joining the Tubes

The tube is then sunk onto this prepared bed as previously described. After the tube is in place and the extending steel shells are connected, the adjoining bulkheads are removed and the remaining interior concrete is placed. This is mixed inside the tube and carefully placed so that the two sections are keyed together. The tremie concrete around the outside of the joint is placed by the tremie plant at the same time the last upper section of the tremie concrete is placed.

Work is progressing simultaneously on the shield-driven tunnel sections, the approach tunnel sections and the open cut sections.

Independent concrete plants, all consisting of 1 cu. yd. mixers and volume proportioning equipment, are used for the work on each section. It is expected to have the entire project completed and ready for use by the late fall of 1930.

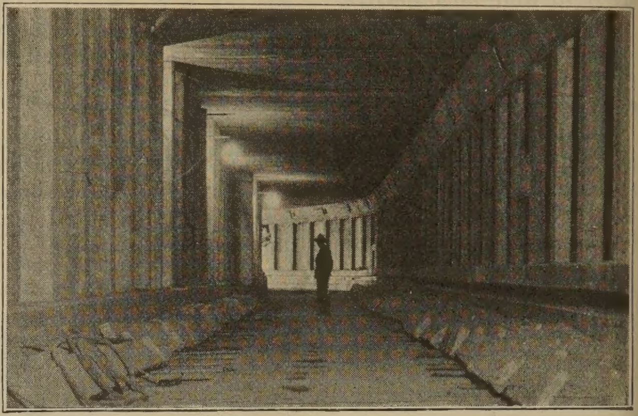


Figure 11. The approach tunnel section on the Detroit side

Personnel

The project is financed by the Detroit and Canada Tunnel Co. Parsons, Klapp, Brinckerhoff & Douglas, consulting engineers, are acting as engineers for the tunnel company, with Burnside R. Value as executive engineer in charge of the project and S. A. Thoresen, engineer at designs.

The general contractors are Porter Brothers and Robert Porter and the Parklap Construction Corporation. The Whitney Bros. Co. is subcontractor on the concrete work and sinking the tubes for the subaqueous section described in this article. The Northern Construction Co., J. W. Stewart & Welch, have the subcontract for the shield driven work.

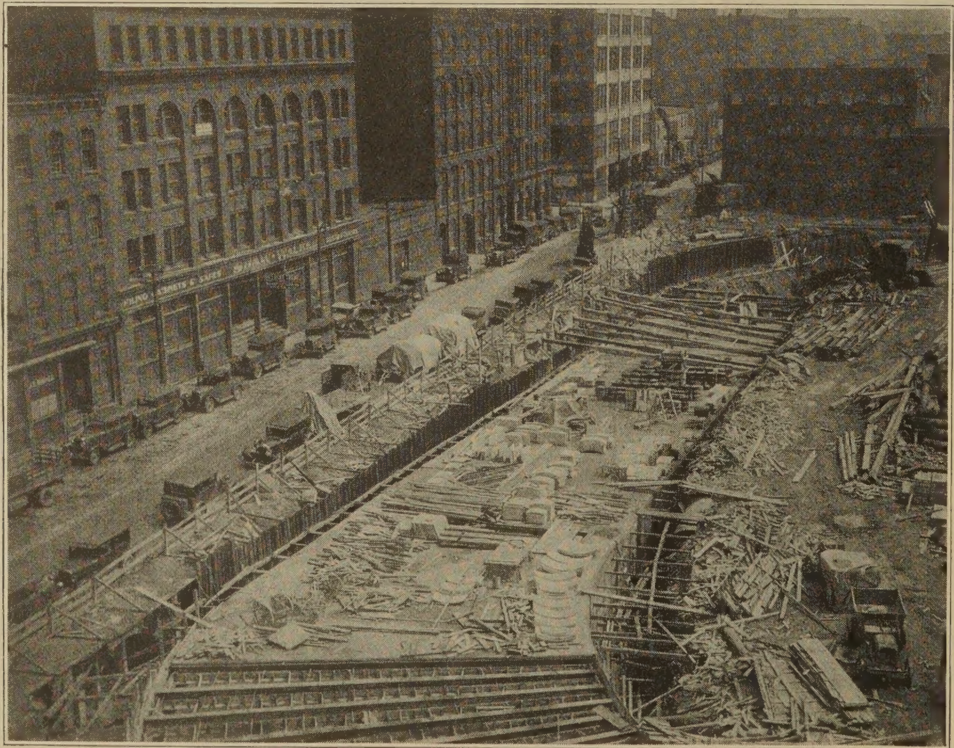


Figure 12. The open cut section on the Detroit side

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth St., New York City.

American Road Builders' Association; Miss E. A. Birchland, Secretary, 29 W. Thirty-ninth St., New York City.
Twenty-seventh annual convention and road show, January 11th to 18th, 1930. Atlantic City, New Jersey.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer, Secretary, 1150 Munsey Bldg., Washington, D. C.

Cast Stone Institute; Frank M. Brooks, Secretary, Pasadena, Calif.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.
Semi-annual meeting, September 30th to October 2nd, Wawasse Hotel, Wawasee, Ind.

Iowa Concrete Products Association; R. L. Gavin, Secretary-Treasurer, 1002 Hubbell Bldg., Des Moines, Iowa.

National Association of Builders' Exchanges; Earl F. Stokes, Secretary, 15 E. Fayette St., Baltimore, Md.

National Concrete Products Association; A. G. Swanson, Secretary, Omaha, Nebr.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N.W., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Building, Cleveland, Ohio.

Northwest Concrete Products Association; W. P. Hews, Yakima, Wash.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 3115 Plankinton Arcade, Milwaukee, Wisconsin.

The Concrete Industry —25 YEARS AGO

BOTH the September, 1904, issue of CEMENT AGE and of CONCRETE published articles dealing with the uses of concrete in subway construction; CEMENT AGE covering the construction of the Rapid Transit Company subway in New York and CONCRETE reporting the construction of the Chicago underground railway.

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SPEAKING editorially of the New York project, CEMENT AGE says: "A great task is done. From City Hall to King's Bridge, New York, has been laid open and into its vitals a new artery has been inserted. * * *

"One thing has made this work possible in the incredibly short time it has taken. That one thing is concrete. Read the papers and you will see running through every one the same refrain; 'concrete construction by its plastic adaptibility relieved us of an infinitude of detail.' "

The editorial is followed by a number of articles written by the men in charge of the various departments of the project. They cover cement testing, concrete mixing and placing, inspection, etc.

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THE article on subway construction published in the September, 1904, issue of CONCRETE describes the construction of the 22 miles of underground freight tunnels in the "loop" district of Chicago. The tunnels are lined with concrete walls 18 in. thick and the floors are concrete slabs 21 in. thick.

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AN article published in CONCRETE twenty-five years ago gives detailed instructions for making concrete sills and lintels and urges block manufacturers to add these specialties to their line of products.

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JUST twenty-five years ago a reader of CEMENT AGE wrote to that publication urging "An association for the cement block trade." Commenting on this letter, the editor said: "* * * These block makers must have the assistance they need and all of them must be interested in the campaign for a higher education of the building construction trades if more rapid advance is to be made.

"Some organized effort must be made in order to produce the desired improvement quickly and this may be the time to begin it. This magazine offers its services in effecting the organization if it is desired, and asks for suggestions from its readers. If the responses to these propositions are favorable, an early call for a meeting will be issued, and it will be as widely distributed as possible."

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"IRRIGATION—a National Problem" is another article in that issue. It argues that the construction of irrigation systems in our arid regions offers a large potential field for concrete engineers and contractors. Helpful design and construction hints are given.

New Equipment and Materials

New Multi-Power Clamshell Bucket

The Erie Steel Construction Company has designed a digging bucket that can be adjusted for the kind of material being dug.

The new bucket is named "Multi-Power" from its working action, which is a combination of two well known principles, namely: the multiple rope and lever arm principles.

The new bucket can be rigged up with 2, 3, 4, 5 and 6 parts of line.

Sheaves are of steel and are kept clean by special sheave cleaners. Large bearings keep the parts in alignment. There are heavy down thrust lugs on the bucket scoops to relieve the rivets. The down thrust is actually on the edge of the bucket—thus forcing the scoops into the materials while closing instead of lifting out.

Lubrication is by the Alemite system, and a grease gun is furnished with each bucket.

Improved Woodworker Increases Capacity 50 Per Cent

Without sacrificing the portability or the versatility of the De Walt woodworker, the manufacturers have developed improvements in their Model "D" machine that makes possible the delivery of fully 50 per cent more power to the work.

This Model D DeWalt Wonder-Worker is powered by a two or three phase, 5 h.p. motor.

Another improvement in this model is the placement of the dial plate with degree markings and pitch scale right out in front of the operator for easy adjustment for angle or bevel cutting. The dial plate is notched at each 45 deg. for the quick finding of such angles.

The De Walt Products Corp., Leola, Pa., is the manufacturer.

A New Buck Anchor

A new buck anchor has just been put on the market by The Bull Dog Floor Clip Company of Winterset, Iowa. It rigidly anchors a wood buck to a clay or gypsum tile partition.

It eliminates the use of nails, bolts, strips of metal lath and strap iron, it is said, engaging the buck on the sides instead of at the back. The sharp pointed barbed ends are driven into the wood with the end of the bricklayer's trowel handle. The back portion is designed to form an immovable truss when it is embedded in the mortar joint.

The Bull Dog buck anchor may be used to anchor almost any kind of a door or window frame to a masonry or concrete wall, according to the manufacturer. It is manufactured in three sizes, 3 in., 4 in. and 6 in.

Paver Skip for Building Mixers

A new, widened, open type of loading skip has been developed by the Lakewood Engineering Company, of Cleveland, Ohio, which can be adapted to 21 and 28-S mixers. Pre-batched material is delivered directly into the skip by trucks. Bins and batcher plants at the job are eliminated.

Air Cushion Expansion Joint

An Air Cushion Expansion Joint recently developed by the Truscon Steel Company, Youngstown, Ohio, consists of metallic sides forming a free air space for expansion. This space is closed at the top by a bellows-shaped piece of galvanized, copper-bearing steel which prevents dirt working into the joint from the surface of the pavement, according to a description contained in an 8-page publication, No. 511.

Dowd Form System Eliminates Hand Rubbing

Light weight and the elimination of hand rubbing, patching and plastering are the claims made for the Dowd concrete form. In addition, the form is said to be absolutely water-tight and non-absorbent, and to require a minimum number of clamps.

Rapid make-up of sides and change in column sizes are said to be possible. Wrecking of the forms is a one-man job, requiring only a carpenter's claw hammer. Forms are assembled with lathing nails. In detailing, the form is outlined by the skeleton.

Dowd Concrete Form System, Inc., Chicago, manufactures the form.

Ransome Brings Out New 7-S Mixer

The Ransome Concrete Machinery Company of Dunellen, N. J., has recently completed a new model of its 7-S standard building mixer.

It is light in weight and is easily moved around on the job.

The tank cuts off accurately and quickl without dribble, it is said. It has a quick setting gauge, as well as a gauge glass.

NOTES FROM THE FIELD

St. Louis Central Mixers

Announcement is made of the consolidation of the *Wet Mix Concrete Company* and the *Commercial Concrete and Material Co.* with the *General Material Co.*, 605 Buder Bldg., St. Louis. Mo. The general offices of the new firm are now located at this address.

As a result of the merger, four St. Louis concrete mixing plants are now operated jointly, delivery being made from the nearest point.

Besser Opens Newark Office

The Besser Manufacturing Company, Alpena, Mich., has opened its own parts station and sales office in the East at 16 Treat Place, Newark, New Jersey.

John H. Thompson is Eastern representative, assisted by *Will Caldwell and James Walch.*

Yale and Towne Buys Steubing

The Yale and Towne Manufacturing Company, Stamford, Conn., recently announced its purchase of the *Stuebing Cowan Company* of Cincinnati, Ohio, and Holyoke, Massachusetts, makers of hand lift trucks.

Bragg Promoted

J. G. Bragg, formerly service engineer, has been appointed eastern sales manager by the *Alpha Portland Cement Co.*

Ottawa Silica President Dies

Edmund B. Thornton, president of the *Ottawa Silica Company*, Ottawa, Illinois, died at his home at Bedford, Indiana, on June 28th.

Ryerson Appointments

H. B. Ressler has been appointed general manager of sales by *Joseph T. Ryerson & Son Inc.* at Chicago, Illinois.

Wm. H. Bryant has become Chicago sales manager in charge of country and city store sales.